APPENDIX B
ENVIRONMENTAL RESOURCES

ENVIRONMENTAL SETTING

GENERAL DESCRIPTION

The Colorado River drains over 42,000 square miles across the state of Texas, of which 18,300 square miles are contained within the Lower Colorado River Basin. Rising from Dawson County, Texas, the river flows approximately 600 miles before emptying into Matagorda Bay and the Gulf of Mexico in Matagorda County, Texas. From its beginning, it flows though rolling prairie terrain before reaching the more rugged Hill Country area near San Saba County. Leaving the Hill Country area, the Colorado passes through the Balcones Escarpment at Austin before flowing across the Coastal Plain to the Gulf of Mexico (The Handbook of Texas Online, 2002).

In addition to residential development, other land uses have impacted the resources of the basin, some more negatively than others. Several gravel pits have been identified within the basin that have not been reclaimed. These areas significantly impair aesthetics, wildlife habitat quality, and water quality.

Within the City of Wharton, the river runs from west to east with the majority of the developed city on the north side of the stream. Two structures have been built to slow the water and control erosion along the stream bank near downtown. The breakwater structures are wooden walls with hollow horizontal empty spaces to allow water to flow though it. Adjacent to the downtown area there is a park on the riverbank to allow pedestrian access to the river. The stream width varies from about 10 to 20 yards though the city. The sediment on the riverbanks is generally silty to clayey loam. The less disturbed areas of the riverbanks are lined with trees such as oak, elm and hackberry. Adjacent to the wastewater treatment plant in Wharton, cement and rock riprap has been placed on the eastern bank of the river. A landfill has also been located near the river within the city that has levies built to protect the landfill from floodwaters.

CANEY CREEK

Caney Creek was originally named Canebrake Creek due to the cane that grew along its sides until white settlement of the area. The creek rises one mile south of Matthews in Colorado County, Texas from a maze of irrigation canals, dead-water sloughs, and old stream channels near the Colorado-Wharton county line. Caney Creek flows toward the southeast across the Coastal Plain approximately 155 miles to the Gulf Intracoastal Waterway (GIWW) near the Gulf of Mexico at the town of Sargent in Matagorda County, Texas (The Handbook of Texas Online, 2002). The Colorado River and Caney Creek channels merge approximately a mile west of Glen Flora before separating again just to the south of Glen Flora. The old streambed of Caney Creek then meanders through the City of Wharton on its path to the GIWW, but it has no continuous flow since the creek has been significantly disturbed in the city of Wharton. As the town grew, the creek was modified and confined to flow though box culverts through the city. The creek is highly disturbed and difficult to follow through town due to construction of homes, schools, and parks over the historic location of the creek bed. East of the city, the creek resumes its normal flow to the southeast.

SAN BERNARD WATERSHED

The San Bernard River rises just south of New Ulm in Austin County, Texas, then flows toward the southeast approximately 120 miles before emptying into the Gulf of Mexico after crossing the GIWW in Brazoria County. The river forms all or part of the county lines between Austin and Colorado, Austin and Wharton, and Wharton and Fort Bend counties and is fed by many smaller creeks, such as Peach Creek.
Peach Creek

Peach Creek rises just west of Farm Road 102 a mile north of Egypt and twelve miles north of Wharton in north central Wharton County. Peach Creek flows toward the southeast to its mouth on the San Bernard River 8 miles southeast of Wharton (The Handbook of Texas Online, 2002). Peach Creek is relatively undisturbed throughout the vicinity of the city of Wharton. The creek is a characteristic bottomland hardwood system dominated by fairly young bald cypress trees. In addition to cypress, many other types of vegetation can be found, including alligator weed, palmetto, water lily, live oak, sagittaria, cedar elm, and cane.

Baughman Slough

Baughman Slough is a tributary of Peach Creek that begins just to the north of Glen Flora. The slough flows to the north, then curves to the southeast before emptying into Peach Creek northeast of Wharton. Baughman Slough is located between Peach Creek and Caney Creek. Baughman Slough in the vicinity of the city of Wharton is highly modified and devoid of most vegetation except grasses. The channel of the slough winds through mainly agricultural pasturelands north of Wharton. The channel is generally about 10 feet wide and the banks of the slough vary between 2 to 5 feet in height. The slough is not fed by springs and is dependent on rainfall runoff for any water flow. Therefore, the slough is dry throughout the year, except for a few small puddles between rain events.

PHYSIOGRAPHY

The proposed project area is located in the Gulf Coastal Plains physiographic province of Texas. The Gulf Coastal Plains province is subdivided into 3 subprovinces named the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies, with Wharton County falling into the Coastal Prairies subprovince.

The Coastal Prairies begin at the Gulf of Mexico shoreline. Young deltaic sands, silts, and clays erode to nearly flat grasslands that form almost imperceptible slopes to the southeast. Trees are uncommon except locally along streams and in oak mottes, growing on coarser underlying sediments of ancient streams. Minor steeper slopes, from 1 foot to as much as 9 feet high, result from subsidence of deltaic sediments along faults (Wermund, 1996).

The elevation of Wharton County ranges from 50 to 150 ft. Most of the county is level to gently sloping from 2 to 5 ft. of fall per mile, causing runoff to move very slowly off the soil. The streams in the county, the Colorado and San Bernard rivers, are entrenched to depths of less than 50 feet (Soil Conservation Service, 1974).

CLIMATE

The proposed project area is located in Wharton County. The climate of the area is generally characterized by hot summers with temperatures averaging 92oF in the July and mild winters with temperatures averaging 41oF in January. The average rainfall for the area is 42.3 inches per year (Texas Almanac, 2002).

GEOLOGY AND SOILS

The soils of Wharton County are generally of the Miller-Norwood, Crowley, Lake Charles, Edna-Bernard, or Edna-Crowley association (Soil Conservation Service, 1974).

Miller-Norwood association soils are moderately well drained to well drained layers of clay and silt loam on bottomlands. The association is generally characterized by calcareous soils in flood plains with clay and loam alluvium underneath. The association covers approximately 19 percent of the county. Approximately 80 percent of the land of the association is used for row crops while the remaining amount is used for pasture. Areas that are not developed generally have a dense cover of trees and brush. The minor soils of this association include Asa, Clemville, Earle, Lincoln, and Pledger series. This association contains the Colorado River and Caney Creek in all of Wharton County, Baughman Slough, the majority of Peach Creek, and the city of Wharton (Soil Conservation Service, 1974).

Crowley association soils are somewhat poorly drained soils with a surface of fine sandy loam over layers of clay and sand clay on uplands. The association covers about 20 percent of the county. Minor soils with this association include Arenosa, Earle, Edna, Konawa, and Tuckerman series. Approximately 20 percent of the acreage of this association is used for row crops or native pasture while the remaining 80 percent is used for rice production in rotation with pastureland. A portion of Peach Creek to the north and west of Wharton crosses this association (Soil Conservation Service, 1974).

Lake Charles association soils are somewhat poorly drained with surface and under layers of clay. The soils are black to dark gray in color and make up approximately 19 percent of the county. Approximately 70 percent of the acreage of this association is used for row crops while the other 20 percent is used for rice production in rotation with pastureland. The minor soils within this association are of the Bernard and Edna series. A portion of Peach Creek to the north and west of Wharton crosses this association (Soil Conservation Service, 1974).

Edna-Bernard association soils are characterized by poorly to somewhat poorly drained fine sandy loams and clay loams at the surface on uplands with underlying clay. The association occupies approximately 31 percent of the county. Minor soils of this association include Crowley, Earle, Lake Charles, Midland, and Tuckerman series. Approximately 60 percent of the acreage of this association is used for row crops while 30 percent is used for pasture and hay fields (Soil Conservation Service, 1974).

Edna-Crowley association soils are somewhat poorly to poorly drained soils with a surface of fine sandy loam with lower layers of sandy clay and clay. The association covers approximately 11 percent of the county with 60 percent of this used for pasture and 30 percent used for rice production with pasture rotation, while row crops use the other 10 percent of this association. The minor soils of this association are of the Bruno, Earle, Hockley, Kenney, Konawa, Lake Charles, and Tuckerman series (Soil Conservation Service, 1974).

The soils of the county are underlain by Pleistocene formations. The soils of the Miller-Norwood Association are the youngest formed from the alluvium of the Colorado River. Caney Creek's current course is a former course of the Colorado River. The time that has passed since

the Colorado River diverted to its present location creating Caney Creek has not been long enough to allow for significant soil differences that form from the alluvium adjacent to the river or the creek (Soil Conservation Service, 1974).

PRIME AND UNIQUE FARMLANDS.

The Farmland Protection Policy Act (FPPA) was included in the Agriculture and Food Act of 1981 and final regulations were published on June 17, 1994. The purpose of the FPPA is to minimize the unnecessary conversion of prime and unique farmland to nonagricultural uses by Federal programs. The Natural Resource Conservation Service (NRCS) administers the land evaluation and site assessment to determine if the potential impacts on farmland exceed the recommended allowable level. Prime farmland soils that are listed by the NRCS for Wharton County and occur within the project area are discussed above. The NRCS lists about 654,321 acres of prime farmlands occurring in Wharton County. An estimated 13,000 acres of prime farmland occurs in the project area.

WATER RESOURCES

Aquifers

The Gulf Coast Aquifer

The Gulf Coast aquifer forms an irregular belt along the Gulf of Mexico from Florida to Mexico. The Gulf Coast aquifer provides water to all or parts of 54 counties in Texas, including Wharton, as it stretches from the Rio Grande to the Louisiana-Texas border. The aquifer consists of complex interbedded clays, silts, sands, and gravels that are connected hydrologically forming a large, leaky artesian aquifer system (Lower Colorado Regional Water Planning Group (LCRWPG), 2000).

The system is comprised of two major components in the Wharton County area: the Evangeline aquifer and the Chicot aquifer. The Burkeville confining layer defines the bottom of the Evangeline aquifer, which is contained within Fleming and Goliad sands. The upper level of the Gulf Coast aquifer system is the Chicot aquifer that consists of the Lissie, Willis, and Beaumont formations, with alluvial deposits overlying the aquifer. Maximum total sand thickness ranges from about 700 feet near the coast to 1,300 feet in the northern extent (LCRWPG, 2000).

The City of Wharton gets its municipal water from deep wells in the Gulf Coast Aquifer. This aquifer is also tapped for irrigation water for farmlands located farther away from the Colorado River in Wharton County. Farmlands closer to the river generally use the river as a source of irrigation water.

Aquatic Resources

The aquatic resources in the study area are confined primarily to the Colorado River, which contains the only permanent water source, two ponds in the Nanya Plastics Sump area, and one man-made pond in the old streambed of Caney Creek. The study area contains approximately 56,000 feet of the Colorado River.

Approximately 96,000 feet of Caney Creek runs through the study area, however, as mentioned above, the only aquatics are mainly contained in the on-man-made pond. Caney Creek does not

function as a creek; it primarily consists of a grass ditch that is several 10-12 feet wide. Several of the remnants of the original streambed of Caney Creek serve as detention pools during rain events. Caney Creek and the section of Baughman Slough in the project area are dry throughout the year, except when there is sufficient rainfall to create runoff conditions in the watershed. The study area contains approximately 59,000 feet of Baughman Slough. Baughman Slough is generally about 10 feet wide through the study area and has limited aquatic resources due it going dry in the summer months. A large ditch in the Alabama Street Sump may contain a few small puddles of water during periods between rainfall events.

The Colorado River is approximately 30-60 feet wide and several feet deep as it flows through the study area. The Colorado River, like most river systems in the eastern half of Texas, is characterized by slowly flowing water. Any river flow makes it difficult for phytoplankton, microscopic algal forms that usually constitute the primary production in an aquatic ecosystem, to maintain substantial populations. As a result, riverine systems are frequently dependent on outside sources of organic material that are washed into the river during local rains.

The primary consumers of the phytoplankton and organic particles in the aquatic ecosystem are zooplankton, generally microscopic animals that are an important part of the food chain in slow moving rivers. The zooplankton, in turn, are preyed upon by macroinvertebrates and numerous fish species. Rotifers are generally the dominant group feeding on phytoplankton, bacteria, protozoa, and other zooplankton, followed by cladocerans and copepods.

Benthic macroinvertebrates in the rivers and lakes form a highly diverse group with a wide variety of functions. In addition to serving as a major food source for vertebrate predators (fish), macroinvertebrates have important roles as herbivores, detritivores, and carnivores. The major groups of macroinvertebrates include insects (primarily immature forms), mollusks (mussels and snails), oligochaetes (aquatic worms), and crustaceans (crawfish and shrimp). Many species of this group require a current to satisfy food and respiratory needs and cannot survive in a standing-water environment, such as lakes and ponds. The greatest diversity of macroinvertebrates in ponds and lakes is usually found along the shallow, vegetated littoral zones.

Fish are prominent in the trophic structure of most aquatic habitats, being the largest, most conspicuous, and recreationally important of the ecosystem's resident consumers. The food habits of fish vary with season, food availability, and life cycle stage. The diet of most young fish and minnows consists of microscopic plants and animals found on plants, in bottom material, or suspended in the water column. As fish develop and attain maturity, feeding adaptations develop and the diets of some species become very restricted. Some fish are herbivorous, while others, such as bass, are strictly carnivorous. Most sunfish and catfish are omnivorous.

Conner and Suttkus (1986) reviewed the zoogeography of fishes from the Western Gulf Slope drainages and reported 59 primary freshwater species native to the Colorado River basin. The ichthyofauna of the Colorado River represents a pronounced break between eastern (typically Mississippi Valley) and western (Rio Grande) fish communities (Mosier and Ray, 1992). Table 3-11, of Mosier and Ray (1992), presents a list of freshwater fishes known to have occurred in the Colorado River, including several native species that appear to have become extirpated in the recent years and several exotic species that have developed established populations.

Wetlands

According to the Texas Environmental Almanac (2000), interior wetlands, which include bottomland hardwood forests, riparian vegetation, inland freshwater marshes, and the playa lakes of west Texas, account for 80 percent of the total wetland acreage in Texas. The vast majority of

these wetlands are located on private property. In the last 200 years, Texas has lost over 60 percent of these inland wetlands due to agriculture conversion, timber production, reservoir construction, and urban and industrial development.

Essential Fish Habitat

Essential fish habitat (EFH) is evaluated under authority of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSFCMA), as amended (16 U.S.C. 1801-1882). The act established national standards that require fishery management plans to create conservation and management measures based on the best scientific information to prevent overfishing and assure optimum yield. The MSFCMA was amended in 1996 by the Sustainable Fisheries Act, which established procedures for identifying EFH and required interagency coordination to further the conservation of Federally-managed fisheries. Rules published by the NMFS (50 Code of Federal Regulations (CFR) Sections 600.805-600.930) specify that any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the act and identifies consultation requirements.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” These waters are generally found in estuaries and tidally influenced sections of rivers that flow into estuaries. Because this project is located well upstream of the Matagorda Bay system and is beyond tidal influence, there are no Federally-managed species that will be affected by this project. Therefore, there are no EFH considerations or consultation requirements needed for this project, and there will be no further discussion of this issue.

Ecologically Unique Stream Segments

The Wild and Scenic Rivers Act, approved on October 2, 1968, establishes a National Wild and Scenic Rivers System and prescribes the methods and standards through which additional rivers may be identified and added to the system. The Act authorizes the Secretary of the Interior and the Secretary of Agriculture to study areas and submit proposals to the President and Congress for addition to the system. It describes procedures and limitations for control of lands in Federally administered components of the system and for dealing with disposition of lands and minerals under Federal ownership. Rivers are classified as wild, scenic, or recreational, and hunting and fishing are permitted in components of the system under applicable Federal and State laws. (Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service). No Wild and Scenic Rivers are located within the project area.

The State of Texas has a similar law, the Texas Administrative Code 357.8, that outlines the process and criteria for designating a river or stream segment in the State as ecologically unique. The criteria used are biological function, hydrological function, riparian conservation areas, high water quality/exceptional aquatic life/high aesthetic value, and threatened or endangered species/unique communities. A regional water planning group can recommend a stream or river segment be designated as ecologically unique and include the recommendation in their regional plan. The Texas legislature can then officially designate a stream segment as having a unique ecological value after it has been nominated by a regional planning group. Designation by the legislature prevents a state agency or political subdivision from obtaining a fee title or an easement that would destroy the unique ecological value of the designated stream. The designated segments also do not have to correspond to classified water quality segments (Ecologically Unique River and Stream Segments).

The Lower Colorado Regional Water Planning Group included a recommendation that the segment of the Colorado River (segment 1402) through Fayette, Colorado, Wharton, and

Matagorda counties be designated as ecologically unique in their adopted plan. The recommendation was based on biological function: undeveloped riverine habitat in the segment, part of the Central Flyway of migratory birds passes over the segment, and the presence of a state-listed endangered species (the blue sucker) in portions of the segment. The Texas Legislature has not taken any action to designate the river segment as unique.

GENERAL WATER QUALITY

The Texas Commission on Environmental Quality (TCEQ) compiles a Clean Water Act Section 303(d) List for Threatened and Impaired Water Bodies every 2 years for submission to the Environmental Protection Agency (EPA). Twenty segments of the Colorado River Basin, were found on the 2000 Clean Water Act Section 303(d) List (TCEQ – Texas 2000 Clean Water Act Section 303(d) List (Dec. 19, 2002), but none of the listed segments are within the project area. No segments within the project area were proposed to be added by the draft 2002 303(d).

VEGETATION

The majority of Wharton County, including the project area around the City of Wharton, is located in the Gulf Prairies and Marshes ecoregion of Texas. The Post Oak Savannah ecoregion covers the remainder of Wharton County and is outside the study area.

Regional Vegetation

The Gulf Marshes, covering approximately 500,000 acres, are on a narrow strip of lowlands adjacent to the coast and the barrier islands (e.g., Padre Island), which extend from Mexico to Louisiana. The Gulf Prairies, about 9 million acres, include the nearly flat plain extending 30 to 80 miles inland from the Gulf Marshes.

The Gulf Marshes are low, wet, marshy coastal areas that range from sea level to a few feet in elevation. The Gulf Prairies are nearly level with slow surface drainage and elevations from sea level to 250 feet (Hatch, 1990). The original vegetation types of the Gulf Prairie were coastal prairie and post oak savannah. Characteristic oak species are live oak and post oak. Typical acacias are huisache and blackbrush. Bushy sea-ox-eye, a dwarf shrub, is also typical (Hatch, 1990).

Principal climax grasses of the Gulf Prairie are Gulf cordgrass, big bluestem, little bluestem, Indiangrass, eastern gamagrass, gulf muhly, tanglehead, and many species of Panicum and Paspalum. Common increasers and invaders are yankeeweed, broomsedge bluestem, smutgrass, western ragweed, tumblegrass, threeawns, and many annual forbs and grasses. Characteristic forbs include asters, Indian paintbrush, poppy mallows, phloxs, bluebonnets, and evening primroses (Hatch, 1990).

Approximately one-third of the inland prairies region is cultivated and is a major area of irrigated crop production, consisting primarily of rice cultivation, for the entire Lower Colorado Region. Bermudagrass and several bluestem species are common in tamed pasturelands.

Vegetation Community Types in the Study Area

Much of the land within the proposed project area, especially along Caney Creek and Baughman Slough, has been disturbed by human activities that have altered the topography of

the landscape. These include construction of roads and instream sewer lines, conversion of land for agriculture, and the building of commercial businesses and residential neighborhoods.

According to the United States Department of Agriculture 1997 Census of Agriculture County Profiles Wharton County had 679,275 acres of land in farms with 722 full time farms. Most of the crops consist of corn, grain sorghum, soybeans, cotton, and rice.

Bottomlands of Special Concern

The USFWS, TPWD, NRCS, Nature Conservancy, and other agencies and environmental organizations have a high priority in protecting the bottomland hardwood forests growing along the Colorado River, San Bernard River, Caney Creek, and Brazos River south of IH-10 to within 6 miles of the Gulf of Mexico. These woods are collectively known as Austin's Woods or the Columbia Bottomlands. In addition to their high biological productivity, they have an importance for neotropical migratory birds which depend on the woods for rest and energy replenishment during migration. The forests are also important resting, breeding, feeding, and escape habitats for a great number of other birds. A significant population of bald eagles is found in the area, due largely to the quality of the breeding habitat (USFWS, 1997).

The Austin's Woods are the only significant expanse of forest adjacent to the Gulf of Mexico in Texas. At the beginning of the 20th Century, the Austin's Woods occupied about 700,000 acres. However, human activities such as logging, agriculture, and development have slowly removed the forests until near the close of the century, it is estimated only 177,000 acres remain. The remaining 25% of the forest ecosystem is highly fragmented and continue to be threatened with commercial and residential development, logging, wetland drainage, and clearing for agriculture. Other threats include pipeline construction, road building, and power line construction. A new venture threatening bottomland forests is the hardwood pulp industry, which has recently clear cut, chipped, and exported hardwoods to Japan for paper production. In an effort to conserve this declining resource, the USFWS has proposed to acquire tracts of the remaining forest from willing sellers and donors and manage them as units of the existing Brazoria National Wildlife Refuge Complex (USFWS, 1997).

Of the over 1000 acres of riparian bottomland hardwoods in the study area, approximately one-hundred could fall into this category. Most of these species are located on the West side of the Colorado River.

Bottomland Vegetation

Bottomlands occur in the transition zone between aquatic and upland ecosystems. Bottomland hardwood systems are considered to be Texas' most diverse ecosystem. Prior to European settlement, Texas had approximately 16 million acres of bottomland hardwood riparian habitat. Today, the state has less than 5.9 million acres. There is expected to be a continual decrease of about 12% per decade due to future projections of pulpwood needs within the United States (Texas Environmental Almanac 2000).

Bottomlands serve several important functions. They contribute to the state's biodiversity. According to the Texas Environmental Almanac (2000), 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 herbaceous plants occur in Texas' bottomlands. They are also known to support 116 species of fish, 31 species of amphibians, 54 species of reptiles, 273 bird species, and 45 species of mammals. At least 74 species of threatened and endangered animals depend directly on bottomland hardwood systems and over 50 percent of neotropical songbirds not listed as threatened and endangered species are associated with these

systems. Besides providing critical wildlife and bird habitat, bottomland hardwood systems 1) serve as catchments and water retention areas in times of flooding; 2) help control erosion; 3) contribute to the nutrient cycle; and 4) play a vital role in maintaining water quality by serving as a depository for sediments, wastes, and pollutants from runoff. Despite these important functions, bottomland hardwoods ecosystems are one of the most endangered ecosystems in the United States (MacDonald et al. 1979). For all of these reasons, the bottomland vegetation system is of great environmental concern in the analysis of the proposed project impact areas.

Bottomland hardwood trees along the Lower Colorado River generally consist of bald cypress, pecan, oaks, elm, cottonwood, and hackberry. Most of these hardwoods are generally mature trees between 50-100 years old that provide food and shelter for wildlife. The banks of the Colorado river within the City of Wharton that have experienced lower levels of disturbance are lined with trees such as oak, elm and hackberry.

The riparian/hardwood forest species growing in the project area where the levees and sumps are proposed consist mostly of mature native pecan trees ranging in height from 30 feet to about 75 feet. These trees possibly invaded the area during past flood events which brought in the nuts that later sprouted and grew in the open fields near the river. Smaller trees scattered across the forested landscape include hackberry (8-20 feet in height), cedar elm (4-12 feet), wooly buckthorn (12-20 feet), cherry laurel (8 feet), and minor occurrences of the invasive Chinese tallow (up to 25 feet in height). Dominant species along the river bank (beyond the proposed project impact zone) include black willow and cottonwoods up to 60 feet in height. One pond of about 3 acres located adjacent to the Nanya Plastics plant appears to be an old oxbow of Caney Creek. It retains a fringe of mature bald cypress trees up to 40 or 50 feet in height. Understory vegetation growing at the base of the mature trees where frequent mowing is used as a management tool for improved pastures include smilex, mulberry, hawthorne, and viburnum, along with a mixture of grape vines, Virginia creeper, and blackberry and dewberry vines.

Peach Creek is relatively undisturbed throughout the vicinity of the city of Wharton. The creek is a characteristic bottomland hardwood system dominated by fairly young bald cypress trees. Other plants found in the Peach Creek vicinity include alligator weed, palmetto, water lily, live oak, sagittaria, cedar elm, and cane.

Trees along the banks of Caney Creek and Baughman Slough are noticeably absent, except where homes are located near the streambeds. Most of these areas are pasturelands with some brush occasionally found in the streambeds. These streambeds, which are dry throughout the year except during moderate to heavy rains, appear to be mowed, at least on an infrequent basis, or grazed to control the growth of brush.

There are over 1000 acres of riparian woodlands or bottomland vegetation within the study area. These are generally located along the Colorado River, Peach Creek, and Baughman Slough.

Grasslands

There are over 11,748 acres of grasslands within the study area. Wharton County grasslands are characterized by the Blackland Prairie ecoregion with tallgrass prairie to the Gulf Coastal Prairie ecoregion with tallgrasses and mid-grasses prairies. Many of the original prairie lands have been lost due to conversion of the land to farmland and cattle ranching. The high quality grasslands include the native vegetation including big bluestem, little bluestem, switchgrass, and sideoats. However, many of these have been converted to low habitat quality coastal Bermuda, King Ranch Bluestem, Johnson grass, and other range grasses that support cattle grazing or converted to rice fields.

Baughman Slough in the vicinity of the city of Wharton is highly modified and consists mostly of grasses along the slopes and dry streambed where it traverses agricultural pasturelands.

FISH AND WILDLIFE RESOURCES

The principal wildlife found in Wharton County are ducks, geese, quail, doves, raccoon, squirrel, nutria, and deer. Wharton County provides wintering grounds for rail, coot, crane, geese, ducks, and other migratory birds. Fish that inhabit the county include bass, channel catfish, and bream. The county is divided into two wildlife sites. The first of which is generally accompanied by soils of the Miller-Norwood association. The areas that are not used for row crops can have cover from pecan, ash, elm, willow, oak, and hackberry trees that provide habitat for deer, squirrels, opossum, rabbit, raccoon, and many kinds of songbirds. The second type of wildlife site is usually accompanied by Edna-Bernard, Crowley, Lake Charles, and Edna-Crowley associations that provide habitat for deer, quail, doves, rabbit, opossum, raccoon, armadillos, and nutria (Soil Conservation Service, 1974).

Amphibians and reptiles are common in the project area and include a total of 25 species of amphibians and 96 species or subspecies of reptiles (Dixon 2000). These species include one siren, two salamanders, a newt, 21 species of frogs and toads, 10 species of turtles, the American alligator, 24 species or subspecies of lizards, and 62 species or subspecies of snakes (Dixon 2000). Widespread turtles within the basin include the common snapping turtle, yellow mud turtle, red-eared slider, ornate box turtle, and softshell turtle. Also, 12 lizard taxa and 37 snake taxa are expected to occur in the project area (Dixon 2000).

During a site visit conducted on 10 January 2006 with the U.S. Fish and Wildlife Service (USFWS), the following species were observed within the riparian forest adjacent to the Colorado River: red tail hawk, red shoulder hawk, vermillion fly catcher, turkey vulture, savannah sparrows, and great egret. Another site visit with the USFWS on 15 June 2006 to three different sites containing grasslands, mixed forest and grasslands, hardwood forest, and wetlands produced a larger variety of birds to add to the list of observations. Birds sighted during this visit included: common grackle, mockingbird, cardinal, Carolina chickadee, yellow-billed cuckoo, mourning dove, swallow-tailed kite, white-eyed vireo, buteo hawk, little blue heron, turkey vulture, belted kingfisher, brown creeper, and eastern meadowlark.

Threatened and Endangered Species

The Endangered Species Act (ESA) (16 U.S.C. 1531 et. seq.) of 1973, as amended, provides a program for the preservation of endangered and threatened species and protection for the ecosystems upon which those species depend for their survival. Federal agencies are required to implement protection programs for these designated species and to use their authorities to further the purposes of the act. The USFWS and NMFS are the primary agencies responsible for implementing the ESA. The USFWS is responsible for birds and terrestrial and freshwater species, while the NMFS is responsible for non-bird marine species.

An endangered species is considered to be in danger of extinction throughout all or a significant portion of its range. A threatened species is considered likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Only those species listed as endangered or threatened by the USFWS or NMFS are afforded Federal protection under the ESA. State-listed threatened and endangered species are not protected under the ESA, but are discussed in this section.

Correspondence with the USFWS and the Texas Parks and Wildlife Department (TPWD) including requests for information, database searches, and a site visit, established the potential presence of 1 Federally-listed threatened species that has been proposed for delisting, 5 State-listed endangered species, and 10 State-listed threatened species that may occur in the project area. These species are shown in Table B-1 The following sections provide descriptions of these species and their habitats relative to the project area. In each section, the species that are listed by the USFWS and/or NMFS are discussed first, followed by a discussion of species that are not Federally-listed, but are listed by the TPWD.

Table B-1
Federal and State Threatened and Endangered Species
that could occur in Wharton County, Texas

Common Name	Scientific Name	Federal Status	State Status
Birds			
American Peregrine Falcon	*Falco peregrinus anatum*	*	E
Arctic Peregrine Falcon	*Palco peregrinus tundrius*	*	T
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*	*	E
Bald Eagle	*Haliaeetus leucocephalus*	T/PDL	T
Eskimo Curlew	*Numenius borealis*	*	E
White-faced Ibis	*Plegadis chihi*	*	T
White-tailed Hawk	*Buteo albicaudatus*	*	T
Whooping Crane	*Grus Americana*	*	E
Wood Stork	*Mycteria Americana*	*	T
Interior Least Tern	*Sterna antillarum athalassos*	*	E
Mammals			
Black Bear	*Ursus americanus*	*	T
Louisiana Black Bear	*Ursus americanus luteolus*	*	T
Reptiles			
Texas Horned Lizard	*Phrynosoma cornutum*	*	T
Timber/Canebrake Rattlesnake	*Crotalus horridus*	*	T
Fishes			
Blue Sucker	*Cycleptus elongates*	*	T

T – Threatened, E – Endangered, PDL – Proposed for delisting, PT – Proposed Threatened
*Not listed by USFWS as a threatened or endangered species with the potential for occurring in Wharton County.

In addition to the State and Federal-listed threatened and endangered species in the list above, TPWD also lists several rare species potentially occurring in Wharton County, but these species have no regulatory listing status on the State list. Thus, they are not listed above and are not included in the species descriptions below. These rare species include one bird (Mountain plover, *Charadrius montanus*), one fish (American eel, *Anguilla rostrata*), one mammal (Plains spotted skunk, *Spilogale putorius interrupta*), and seven mollusks (Creeper (Squawfoot), *Strophitus undulates*; False spike mussel, *Quincuncina mitchelli*; Pistolgrip, *Tritogonia verrucosa*; Rock-pocketbook, *Arcidens confragosus*; Smooth pimpleback, *Quadrula houstonensis*; Texas fawnsfoot, *Truncilla macrodon;* and Texas pimpleback, *Quadrula petrina*).

Birds

The bald eagle has recovered sufficiently to be downlisted to threatened thoughout its range and the USFWS has proposed to completely delist the species in the near future (64 FR 36453-36463; July 6, 1999). Two subspecies are currently recognized based on size and weight. The northern subspecies nests from central Alaska and the Aleutian Islands through Canada into the northern U.S. The southern subspecies primarily nests in estuarine areas of the Atlantic and Gulf coasts, northern California to Baja California, Arizona, and New Mexico (Snow, 1981). Wintering ranges of the two populations overlap. The bald eagle inhabits coastal areas, rivers,

and large bodies of water as fish and waterfowl comprise the bulk of their diet. Nests are seldom far from a river, lake, bay, or other water body. Nest trees are generally located in woodlands, woodland edges, or open areas, and are frequently the dominant or co-dominant tree in the area (Green, 1985). Concentrations of wintering northern eagles are often found around the shores of reservoirs in Texas, with most wintering concentrations occurring in the eastern part of the state. Wintering bald eagles in Texas have been observed as far south as Cameron County (Oberholser, 1974) and are considered to be a rare permanent resident in the Coastal Bend (Rappole and Blacklock, 1985). TPWD surveys have recorded nests as close as 5 miles upsteam of Wharton on the Colorado River near Glen Flora.

All North American peregrine falcons were delisted from the Federal list of threatened and endangered species in 1999 (64 FR 46541-46558, August 2, 1999). The Arctic peregrine falcon, which was listed as endangered due to similarity of appearance to the American peregrine falcon was delisted Federally, but remains on the TPWD threatened list. The primary differences between the subspecies are their ranges and migration patterns. The Arctic peregrine falcon nests only from northern Alaska to Greenland and winters along the entire Gulf Coast. It occurs statewide during migration (USFWS, 1995). The American peregrine falcon remains on the State endangered list and nests from central Alaska across north-central Canada to central Mexico. It also overwinters in Texas and both subspecies could potentially occur in the project area, especially during spring and fall migration.

Attwater's greater prairie-chicken is a medium-sized grouse (TPWD, 1995). This species was once a common resident on most of the Texas coastal plain, including parts of Wharton County. However, the abundance of this species is currently declining from Galveston County to Aransas and Refugio Counties (USFWS, 1995). Remaining populations of Attwater's greater prairie-chicken are found only in the Texas costal prairie where native tallgrass prairie habitat still exists. No suitable habitat for Attwater's greater prairie-chicken is present in the project area.

The current status of the Eskimo curlew is considered uncertain and possibly extinct, but the species is Federally and State-listed as endangered. This species was very abundant in the nineteenth century, but was subject to extreme hunting pressure. The breeding habitat of the Eskimo curlew was treeless arctic and subarctic tundra (Gill, et al., 1998). Non-breeding birds use a variety of habitats, such as grasslands, pastures, plowed fields, and less frequently, marshes and mud flats (AOU, 1983). Spring migration would bring them through Texas and the midwestern U.S. (Gill, et al., 1998) from mid-March to late April (Oberholser, 1974). One record does exist from Galveston, Texas in 1962, and others since then have been reported. However, the validity of these records is uncertain. The Eskimo curlew is unlikely to occur in the project area due to its extreme rarity and the lack of recent records of occurrence.

The white-faced ibis is a coastal species that inhabits a variety of freshwater and estuarine environments. It is considered a rare to uncommon spring and fall migrant throughout Texas and a rare to uncommon post-breeding visitor north and west of its usual breeding range within Gulf coast counties (TOS, 1995). One sighting was recorded for this species in Wharton County in Oberholser (1974), but this species may migrate through the area and feed in the rice fields.

The white-tailed hawk is a large raptor that inhabits undeveloped coastal grasslands and inland mesquite-oak savannahs (Oberholser, 1974). White-tailed hawks are considered uncommon local summer residents of the coastal plain from Harris and Colorado Counties to south of the Rio Grande (TOS, 1995). This species may migrate through Wharton County and feed in any of the numerous pasturelands.

Each year the only remaining natural wild population of whooping cranes migrates 2,600 miles from its summer nesting grounds in Canada's Wood Buffalo National Park to its wintering grounds at Aransas National Wildlife Refuge in Aransas, Refugio, and Calhoun Counties. During

migration, the whooping crane makes regular stops, during which they use a variety of habitats that are generally isolated from human activity. It can be found in the marshes of Matagorda and St. Joseph's Islands where it feeds mainly on blue crabs and clams. However, the birds will wander inland to oak mottes, swales, and ponds to feed on acorns, snails, crawfish, and insects (Campbell, 1995). The project area lies within the migration corridor, but it is unlikely the whooping crane will stop here due to human activity in and near the city.

Wood storks are semi-aquatic birds that prefer a variety of wet environments, including forested wetlands, irrigated fields and pastures, prairie ponds, and mudflats (Coulter, et al., 1999). Preferred habitats include coastal marshes, bays, prairies, and lakes (Sarkozi, 1996). They are not generally associated with upland areas with dense ground cover. The wood stork is a migratory species and is a common summer resident on the coastal plains from July to September (Sarkozi, 1996). The wood stork has been sighted in Wharton County and the project area contains habitats that may be used by this species. Therefore, this species could occur in the project area.

The interior least tern is a colonial nesting shorebird adapted to lacustrine and riverine sandbar and gravel beach habitats and has historically nested on sandbars of the Colorado River, Rio Grande, and Red River in Texas. Small, remnant breeding populations persist at isolated locations within its historic range. This species winters along the entire Texas coast, but the USFWS considers any least tern within 50 miles of the coast to be the coastal subspecies and, thus, not protected by the ESA (USFWS, 1995). Although listed as potentially occurring in Wharton County by TPWD, the USFWS does not list it on their county list for Federally-listed threatened and endangered species. Therefore, the occurrence of this species in the project area is highly unlikely.

Mammals

Black bears were historically widespread throughout Texas, but are now restricted to remnant populations in mountainous areas of the Trans-Pecos region (Davis and Schmidly, 1994). The Louisiana black bear, which is one of 16 recognized subspecies of black bear (Hall, 1981), was historically found in eastern Texas. It is distinguished from other black bears by its longer, more narrow, and flat skull and by it proportionately large molar teeth (Nowak, 1986). This subspecies is now restricted primarily to the Tensas and Atchafalaya River Basins in Louisiana, where its habitat consists primarily of bottomland hardwood timber. The Louisiana black bear is not known to occur in Texas, although potential habitat exists in the project area.

Reptiles

The Texas horned lizard has a broad and flattened body, short tail, and conspicuous elongated scales that form spines on the head, neck, and back. Texas horned lizards historically were widespread throughout Texas, but have experienced a rapid decline in number, possibly due to widespread use of insecticides, the introduction of imported red fire ants, and a decline in harvester ants, which are the lizard's primary food source. It has almost vanished from the eastern half of the state (Price, 1990). However, Bartlett and Bartlett (1999) state that the actual status of populations of this species is unknown. Since it has historically occurred in the region, the presence of the Texas horned lizard in the project area cannot be discounted.

Timber/canebrake rattlesnakes generally occur in lowland areas such as swamps, cane brakes, riverine thickets, pine and deciduous woodlands, and abandoned farmland, preferably with dense undergrowth. It primarily inhabits moist lowland forests and hilly woodlands near rivers, streams, and lakes in the eastern third of the state (Werler and Dixon, 2000). However, it can also be found in open, upland pine and deciduous woods and the second-growth pastures of

unused farmland. Because the preferred habitat for this species occurs in the project area, the potential for its occurrence cannot be ruled out.

Fish

The State-listed threatened blue sucker inhabits the larger portions of major rivers in Texas, usually within the deeper channels and flowing pools with a moderate current. Bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel. The adults winter in deep pools and move upstream in the spring to spawn on riffle beds. Construction of impoundments has led to a reduction of suitable silt-free gravel and rock bottoms by slowing the formerly constant strong flows and has led to blocked migratory routes resulting in depressed population levels. This species is known from further upstream in Colorado County in Stream Segment 1402 of the Colorado River (Celeste Brancel, TPWD, internet communication). This segment of the river flows through Fayette, Colorado, Wharton, and Matagorda Counties, including the project area. The TPWD Annotated County Lists of Rare Species for Wharton County last revised on December 11, 2002 does not list the blue sucker as occurring in Wharton County. However, the potential exists that this species could occur in the project area.

Migratory Birds

The Colorado River bottomland forests in Wharton County are classified as part of the Austin's Woods or Columbia Bottomlands habitat. This once extensive hardwood forest occurs in the basins of the lower Colorado River, San Bernard River, Caney Creek, and Brazos River from within 6 miles of the Gulf coast to 50 miles inland. Besides their high biological productivity, these forests are critical to the survival of neotropical migratory birds which annually migrate in the spring from Central and South America and the Caribbean Islands across the Gulf of Mexico to their nesting areas in the United States and Canada. These birds depend on the Austin's Woods area for rest and replenishment during migration. Other birds using these habitats include migratory waterfowl, wading birds, colonial nesting birds, and migratory shorebirds. Investigations of the importance of these forests found that 237 species of birds totaling 239 million individuals migrate through the area each year. Therefore, the loss of this habitat could have significant consequences for these migratory birds (USFWS, 1997).

AIR QUALITY

Wharton County is located in the EPA Air Quality Control Region (AQCR) 216. The EPA uses six "criteria pollutants" as indicators of air quality and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are referred to as the National Ambient Air Quality Standards (NAAQS). The areas of the country where air pollution levels persistently exceed the standards may be designated as 'Nonattainment' areas.

Areas of the country where the air pollutant concentration meets the national primary air quality standard are designated as being in "Attainment". An "unclassifiable" designation is ascribed to areas of the country that cannot be classified based on available information. A subclassification may be ascribed by the EPA to areas that are currently in nonattainment. This classification describes the level of a particular air pollutant as being Severe 17, Severe 15, Serious, Moderate, Marginal, Submarginal, Section 185A, or Incomplete (no data). The information presented represents the most relevant and accurate description of existing conditions for air quality within the study area since it is not feasible to establish air pollutant monitoring stations at specific project site locations.

The proposed project area is classified as being in Region 12 by the TCEQ, the state agency responsible for meeting National Ambient Air Quality Standards (NAAQS). Wharton County is in attainment for all criteria pollutants; however, it is adjacent to Brazoria and Fort Bend Counties, which are in non-attainment for ozone pollution. The Houston Air Plan has been approved by the Texas Commission on Environmental Quality and has been forwarded to the Environmental Protection Agency for its approval to bring these counties into attainment for ozone by 2007.

NOISE

Pursuant to the Noise Control Act of 1972 as amended by the Quiet Communities Act of 1978, the EPA has developed appropriate noise-level guidelines, The EPA generally recognizes an average day-night noise level (Ldn) of less than 50 decibels a-weighting (dBA) (USEPA, 1978) for rural areas and between 55 and 60 dBA for urban areas. Hearing loss could result if the average outdoor noise level is in excess of 70 dBA or more for 24 hours over a 40-year period (USEPA, 1974). Several factors affect response to noise levels, including background level, noise composition, and level fluctuation, time of year, time of day, history of exposure, community tolerance, and individual emotional factors. In general, people are more tolerant of a given noise if the background level is closer to the level of the new noise source. People are more tolerant of noises during daytime than at night when background noise normally diminishes, increasing sound awareness. Residences are also more tolerant of an activity if it is considered to benefit the economic or social well-being of the community or them individually. Noise levels have a much greater affect on outdoor than indoor activities. The project area is located within the City of Wharton. Sound levels in the project area are affected by vehicular traffic on local highways and roads, construction activities in the area, and commercial and residential activities.

SOCIOECONOMIC RESOURCES

The Texas Comptroller of Public Accounts (TCPA) is the controlling authority of the state economy, audits accounts, and supervises financial affairs of Texas. TCPA has developed an economic model that divides the state's 254 counties into 13 regions based on similarity in socioeconomic indicators. Wharton County is located in the Gulf Coast socioeconomic region.

Environmental Justice

On February 11, 1994, President Clinton issued Executive Order (EO) number 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations." In general, the order states that Federal agencies shall specifically analyze environmental effects of Federal actions, including health, economic, and social effects, on minority and low-income populations, as part of the analysis prepared for the national Environmental Policy Act (NEPA). The EO is designed to focus the attention of Federal agencies on the disproportionate impacts to health or environment that could result from undertakings in areas of minority and/or low-income communities. It further directs agencies to identify potential effects and possible mitigation measures in consultation with the identified affected communities. In order to determine these potential impacts to minority and/or low income populations within the study areas that are planning or participating in potential projects described, the information obtained from a review of the existing demographic and census data should be combined with a series of community participation meetings designed to draw responses from segments of the

community which typically will not be responsive to traditional NEPA information requests and meetings.

ENVIRONMENTAL CONSEQUENCES

This section describes the potential impacts, both beneficial and adverse, of the No-Action and Preferred Alternatives on the human and natural environment. Impacts can be direct or indirect (i.e., secondary or synergistic) and short-term, long-term, or permanent. They can vary from a negligible change in the environment to a total change. Impacts that would result in substantial changes to the environment should receive the greatest attention in the decision-making process.

NO-ACTION ALTERNATIVE

The No-Action Alternative would be implemented only if the preferred alternative or other alternative analyzed in the EA could not be constructed. This would result in the area remaining in its present condition, unless there are alterations to the environment as the result of future non-Federal construction in the area. However, there is little likelihood of any significant development taking place in the project area, given the past history of the city, unless improvements are made to reduce or eliminate flooding.

Physiography/Geology/Soils

The No-Action Alternative would not impact the physiography or geology of the project area. Any impact of this alternative on the surface soils of the area would depend on the type of future development that would take place in the area. The No-Action Alternative would mean that the City of Wharton would continue to experience flooding of the downtown and surrounding area with the loss of property and economic opportunity for business and agricultural interests.

Climate

Under the No-Action Alternative, no significant impacts to the climate would result.

Prime and Unique Farmlands

Under the No-Action Alternative, the soils would remain unaffected and no farmland would be lost as the result of Federal actions.

Water Resources

The No-Action Alternative would have little impact on the surface or groundwater resources in the project area. The City of Wharton would continue to try to relieve flooding problems by building new or enlarging existing drainage ditches. These activities could lead to minor, temporary increases in turbidity in the river as a result of erosion in the banks of the ditches until vegetation can regrow.

Vegetation

Vegetation in the project area would be unaffected if the No-Action Alternative is implemented. Some minor losses of trees could occur in limited areas near the river as a result of continued borrow activities to supply sand and fill materials for local construction projects. There are at least two borrow sites located in the project area: one at the proposed Nanya Plastics Sump and the other near the Ford Street Sump.

Fish and Wildlife

If this alternative is implemented, no adverse impacts to wildlife habitats or wildlife species in the project area are expected to occur. Future development could impact these habitats and species, but it is not likely, given the history of development activities in the area and the continued threat of periodic flooding. No impact on aquatic species or migratory birds is anticipated as a result of this alternative.

Threatened and Endangered Species

No impacts to threatened, endangered, or rare fish and wildlife species are anticipated under the No-Action Alternative.

Air Quality

Under the no action alternative there would be no impacts to air quality.

Hazardous, Toxic, and Radioactive Wastes (HTRW)

Under the no action alternative there would be no impacts to HTRW.

Noise

Under the no action alternative there would be no impacts related to noise.

Socioeconomic Resources

Under the no action alternative there would be no changes to impacts currently occurring to this resource.

Cultural Resources

Under the no action alternative there would be no anticipated impacts to cultural resources.

PREFERRED ALTERNATIVE

It is anticipated that the Preferred Alternative would alleviate or reduce flood damages occurring from the 100-year frequency event for the project area around the City of Wharton. The potential impacts to the area's resources as a result of project construction are described below.

Physiography/Geology/Soils

No significant impacts to the physiography or geological resources of the project area are anticipated as a result of the proposed project. However, the project will alter the soils on about 214 acres of land where the levees, sumps, and channel improvements in Baughman Slough will be constructed. The earthen levees will be seeded and returned to grassland habitat for most of the area. About 163 acres of land will be excavated for the sumps and the original grassland and forested habitat altered for temporary water storage. Much of the sump area will be reseeded with grass and trees replanted in the sumps to eventually return the area to a habitat resembling the one removed by construction.

Climate

No impacts to the climate are expected as a result of activities associated with the Preferred Alternative.

Prime and Unique Farmlands

Approximately 214 acres of surface soils will be impacted by construction activities associated with the Preferred Alternative. About 170 acres of this land is considered prime farmland. However, about 51 acres of earthen levees will be reseeded and returned to a grassland habitat suitable for livestock grazing, except in the urban environment, and as much as 171 acres in as yet unidentified storage sites will be used for storing the excess material excavated from the sumps. These storage areas will be located in open fields and reseeded with native grasses. These areas would be available for livestock grazing. Only about 2,290 feet of floodwalls and 162.9 acres of sumps will be permanently altered and no longer available for agricultural use. Coordination with the NRCS on scoring project impacts to prime farmland was accomplished on 9 January 2006 and again on 7 July 2006 due to project changes. The NRCS determined that project impacts to prime farmland soils scored 118 points, which is below the threshold value of 160. Any value above 160 points would trigger analysis of project alternatives to reduce impacts to prime farmlands. Therefore, this issue does not require further consideration. A copy of the NRCS letter dated 17 July 2006 is included in Appendix H.

Water Resources

Surface and Groundwater

Construction of the proposed project could cause short-term disturbances resulting in potential impacts to water resources through soil erosion. The main potential impacts on water resources are siltation resulting from erosion and runoff from hauling and constructing the earthen levees, construction of ditches to return the stored flood waters in the sumps, and the stockpiling of excess excavated materials from the sumps. Best management practices will be used to

reduce erosion of bare earth surfaces along the levees, ditches, and stockpile areas, such as using hay bales, jute matting, silt fences, sand bags, and mulching, until the areas can be seeded to reestablish native vegetation that will help control erosion. Also, only the vegetation that is absolutely necessary to clear an area for construction will be removed.

To reduce the potential for petroleum products entering the Colorado River, Caney Creek, or Baughman Slough, contractors will take measures to prevent spills and leaks from their equipment. Littering in construction areas will be discouraged and surplus and waste materials will be removed from the work site and disposed of in a permitted disposal area. Spills of fuel, lubricants, or other petroleum products increase the potential for impacts to groundwater. The most effective method to avoid groundwater impacts is the proper implementation of spill-prevention and spill-response plans. Pollution from normal operation of heavy equipment during construction activities is unlikely to result in any groundwater contamination.

Vegetation

The Preferred Alternative consists of several flood protection features: a levee along the Colorado River and a segment of Baughman Slough, sumps located adjacent to the levees to collect floodwaters inside the city, channel enlargement on a section of Baughman Slough downstream of the levee, and storm water conveyance systems to drain storage areas within Caney Creek. The Preferred Alternative was designed to minimize impacts to riparian habitat along the Colorado River by pulling the flood protection levee back from the river bank as much as possible and locating the structure on the top of the river bank inside the city in an urban environment. This location also accomplished a reduction in levee height needed to provide the requisite flood protection and lowered the cost of the project. Existing features, such as the railroad embankment for the Kansas City-Southern Railroad and existing ditches were also utilized to reduce project impacts and costs. However, even with these precautions, approximately 64.9 acres of riparian/hardwood forest will be removed during project construction, along with 128.6 acres of grassland (Figures B-1through B-7). Most of the grassland will be recreated by seeding the earthen levees and stockpile areas with native grasses.

Wetlands

The USFWS National Wetland Inventory data for the project area showed scattered wetlands along parts of the Colorado River, in Baughman Slough, in tributaries feeding Baughman Slough, in Caney Creek, in old oxbows of Caney Creek, and in some swales and ditches draining some of the pastures and woodland areas outside the city. Most of these wetlands are ephemeral and contain water only after moderate to heavy rainfall events. However, these wetlands still retain wildlife value, especially during wet years. These wetlands total about 118 acres.

All of the wetlands currently have jurisdictional status under Section 404 of the Clean Water Act and will remain jurisdictional after the project is completed, even though they will be removed from the 100-year floodplain. The wetlands in Caney Creek and its old oxbows will remain jurisdictional because they will retain their hydraulic connection to the Caney Creek watershed. The remaining wetlands that drain into Baughman Slough or the Colorado River will retain their hydraulic connections because the tributaries and drainages will be allowed to pass under the levees through culverts with flapgates on the river or slough side. The flapgates will prevent water from backing up into the city during a river rise, but the connection and, therefore, jurisdiction over the wetlands still remains. Since none of these wetlands outside the sump areas are otherwise affected by the project, mitigation is not needed.

The only wetlands to be negatively impacted by the project are about 1.4 acres where the Colorado River crosses 7 small drainages, 5.0 acres that will be removed during channel enlargement at Baughman Slough, 2.0 acres in a drainage ditch next to the Alabama St. Sump, and 1.5 acres in the Nanya Plastics Sump. The Nanya Plastics wetlands consist of a small ditch about 5-6 feet wide and 200 feet long that drains into an ephemeral pond at the bottom of a borrow pit. During the last site visit on 15 June 2006, the total area of these wetlands was about 1 acre. Another wetland of about 2.5 acres is located on the west side of the Nanya Plastics Sump and appears to be a remnant oxbow from a past meander of Caney Creek. This is a permanent wetland of higher wildlife habitat quality than any of the other wetlands in the project area. It is circled by a 100-200-foot wide band of fairly mature forest and has several mature bald cypress trees on the perimeter of the pond. This wetland will not be removed during construction of the sump, but it could be flooded during locally heavy downpours and a simultaneous rise of the river which prevents the water in the sump from draining under the levee to the river. The oxbow wetland will retain its jurisdictional status since it retains a hydraulic connection to the Colorado River through a flapgated culvert under the levee. The two smaller wetlands inside the sump will be lost during construction, but they will be recreated in the sump and revegetated with emergent vegetation and trees as part of the mitigation plan during project construction.

Riparian/Hardwood Forests

The riparian/hardwood forest habitat that will be removed during project construction consists mostly of mature native pecan trees, with some hackberry, wooly buckthorn, cedar elm, and cottonwoods intermixed. There is very little brush or other understory vegetation, except around the base of the mature trees due to occasional mowing to maintain the pasture lands. Even the areas not used as pastureland in the urban setting are mowed frequently since they can be used for recreation. The one exception is the Nanya Plastics Sump where a more natural mix of native trees and brush can be found, including native pecan, hackberry, black willow, and cherry laurel. The non-native Chinese tallow also has invaded the area and is becoming widespread at this site. Much of this land was used as a borrow site around 12-15 years ago and the original trees and vegetation stripped for access to the sand.

Table B-2 shows the area of forest, wetland, and grassland habitat that will be affected by project implementation.

Table B-2
Impacts of the Recommended Plan Features to Habitat Types

Project Feature	Length (ft)/ Size (ac)	Habitat Impacts			
		Forest	Grass	Wetland	Resident
Levee					
Colorado R.	20,310 ft. (earth) 1,910 ft. (floodwall)	14.9 ac.	14.1 ac.	1.4 ac.	0
Baughman S.	6,610 ft. (earth) 380 ft. (floodwall)	7.6 ac.	14.5 ac.	0	0
Channel Improvement					
Baughman S.	6,830 ft. (75 ft. wide)	0	0	5.0 ac.	0
Sumps					
Wal-Mart	32.3 ac.	11.2 ac.	21.1 ac.	0	0
Nanya Plastics	41.7 ac.	22.5 ac.	17.7 ac.	1.5 ac.	0
Hughes St.	28.0 ac.	6.0 ac.	22.0 ac.	0	0
Ford St.	3.2 ac.	0.2 ac.	2.6 ac.	0	0.4 ac.
Sunset St.	1.7 ac.	0.8 ac.	0.2 ac.	0	0.7 ac.
Black/Collins	3.8 ac.	1.0 ac.	2.8 ac.	0	0
Alabama St.	9.3 ac.	0	7.3 ac.[1]	2.0 ac.	0
Baughman S.-Railroad	34.5 ac.	0	25.2 ac.	0	9.3 ac.
Baughman S.-Ahldag	8.4 ac.	0	8.4 ac.	0	0
Caney Creek Storage					
Outfall Storage Drainage	300 ft. *	0.4 ac.	0	0	0
Wharton Storage Drainage	0	0	0	0	0
Crestmont Storage	250 ft. *	0.3 ac.	0	0	0
Sante Fe Ditch					
Disposal Areas	65 ac < 171 ac.**	0	171 ac.	0	0
Total		64.9 ac.	299.6 ac.	9.9 ac.	10.4 ac.

[1] The Alabama St. Sump is located in a cropland and does not contain grassland, except a small amount in a ditch.
* Distance from levee/road to river that crosses forest or wetland habitat.
** The disposal areas would impact at most 171 acres if the excess materials are spread 4 feet high. Materials would only be disposed of on grass or open agricultural fields.

Colorado River Levees – The levees along the Colorado River generally cross (1) pastureland west of Hwy. 59, some of which contain hardwood forests; (2) riparian habitat at the Nanya Plastics site; and (3) mostly urban habitat through the city with little or no forest habitat to the east end of the project. Approximately 15 acres of riparian/hardwood forest habitat will be removed during levee construction and will be compensated as described in the mitigation plan.

Wal-Mart Sump – This 32.3-acre sump is located in a pastureland consisting of about 11.2 acres of hardwood forest and 21.1 acres of grassland habitat (Figure B-1). About 253,000 cubic yards (cy) of material will be excavated from the sump, which will be used to collect water

from local flooding. Some of the excavated material will be used to construct the nearby levee and the remaining material will be stored in an open field to be identified during the PED Phase.

Nanya Plastics Sump – This 41.7-acre sump consists of about 22.5 acres of riparian/hardwood forest habitat, 1.5 acres of wetlands, and 17.7 acres of grasslands (Figure B-2). Approximately 41,000 cy of material will be removed from the sump and stored in an open field to be identified during the PED Phase.

Hughes St. Sump – This 28-acre sump is located in pastureland and contains about 6.0 acres of hardwood forest and 22.0 acres of grassland (Figure B-3). Approximately 42,700 cy of material will be excavated for the sump.

Ford St. Sump – This approximately 3.2-acre sump is located in an open field with a few scattered trees in an urban setting (Figure B-4). About 16,700 acres of material will be removed from the sump.

Sunset St. Sump – This is the smallest sump in the project with an area of about 1.7 acres. It is located in a residential area and consists of open field and residential yards (Figure B-4). About 25,000 cy of material will be removed from the sump.

Black/Collins St. Sump – This 3.8-acre sump consists of open field with some scattered trees in an urban setting (Figure B-5). About 29,500 cy of material will be removed from the sump.

Alabama St. Sump – This 9.3-acre sump is located in a corn field at the downstream end of the Colorado River levee (Figure B-6). A large drainage ditch runs along the north side of the sump and contains mostly brush and tall grass in the channel. Approximately 213,000 cy of material will be removed from the sump.

Baughman Slough Levee – The levee along Baughman Slough crosses about 7.6 acres of forest and 14.5 acres of grassland habitat. Material to build the levee will come from the soil excavated from the nearby sumps.

Baughman Slough Railroad Sump – This 34.5-acre sump is located at the western end of the project in a pastureland next to Baughman Slough (Figure B-7). Approximately 9.3 acres of the site consists of residential yard with pecan trees. The rest of the sump will be excavated from 25.2 acres of pasture. About 269,000 cy of material will be removed from the sump.

Baughman Slough Ahldag Sump – This 8.4-acre sump consists of pastureland with a few scattered trees (Figure B-8). About 156,000 cy of material will be removed to create the sump.

Disposal Areas - About 1,302,300 cy of material will be excavated for the sumps and toe collector ditches. Only about 201,300 cy of this material will be needed to construct the earthen levees, leaving about 1,102,000 cy of material that will need to be disposed of. As discussed in the Interior Drainage Section of the chapter, there would be a need of permanent disposal area of approximately 68 acres of land if the excess materials are piled 10-feet high and 171 acres would be needed if it is piled 4-feet high. These impacts would only be to upland grasslands and after the disposal is complete, the areas would be reseeded and returned to grasslands, so no mitigation would be required.

In aggregate, about 64.9 acres of riparian/hardwood forest will be removed during construction of the levee and sump system. About 1,302,300 cy of material will be excavated for the sumps and toe collector ditches. Only about 201,300 cy of this material will be needed to construct the earthen levees, leaving about 1,102,000 cy of material to be stockpiled at one or more unidentified storage areas that will be located in open fields to minimize impacts to valuable

habitat. Approximately 68 acres of land will be needed for stockpiling the excess material if it is piled 10-feet high and 171 acres will be needed if it is piled 4-feet high.

A total of about 299.6 acres of grasslands will be removed during project construction. Up to 171 acres will be used to store excess material excavated from the sumps, but this land will be reseeded with native grasses to reclaim its original habitat. Up to 45 acres of earthen levees will also be reseeded with native grasses to reclaim part of the lost habitat. Because this resource is neither rare nor declining on a local, regional, or national scale, it will not be included in the mitigation plan.

Fish and Wildlife

Threatened and Endangered Species

A biological evaluation was conducted for this project for the purpose of fulfilling the USACE requirements as outlined under Section 7(c) of the Endangered Species Act of 1973, as amended. The evaluation was reviewed by the USFWS to ensure that all potential project impacts have been discussed and coordinated with the appropriate agencies. Since the USACE concluded the project would not affect the only Federally-listed threatened species for the county, no further consultation was needed. A description of potential project impacts to all species listed by the Federal Government and the State of Texas for Wharton County is presented below.

The bald eagle is the only species listed on the USFWS county list for Wharton County. The closest bald eagle nest to the project area is located near Glen Flora about 5 miles upstream from the project area in the City of Wharton. Discussions with the TPWD and local city officials indicated that there were no known sightings of eagle nests or the birds roosting in the project area. However, since there is the potential for a pair of eagles to take up residence and construct a nest in the project area, the site will be reevaluated each fall just prior to and during project construction to ensure there will be no project impacts to this threatened species. The reevaluation will consist of coordination with the USFWS, TPWD, and local city officials or other knowledgeable local residents to elicit information on eagle sightings, as well as an informal survey of suitable wooded areas for nests.

The American peregrine and Arctic peregrine falcons have the potential of migrating through the project area during construction of the levees and sumps; however, the construction activities are expected to have only a temporary impact and the birds can easily avoid the area until construction is complete.

Project construction is not expected to have any impacts on the Attwater's greater prairie chicken, Eskimo curlew, whooping crane, or the interior least tern since they have little, if any, potential of occurring in the project area.

Both the white-faced ibis and white-tailed hawk are rare to uncommon visitors to Wharton County, but if they do visit the project area, it is doubtful that project construction will have any impact on these species, except a temporary one, since they can easily avoid the disturbance.

The wood stork is not a common visitor to Wharton County, but if one should wander through, it could easily avoid construction. Any impacts would be temporary.

Project construction is not expected to have any impact on the black bear or Louisiana black bear since there are no records of any occurring in the project area in recent times and there is little likelihood of one appearing in the area during project construction.

The Texas horned lizard and the timber/canebrake rattlesnake have the potential of occurring in the project area and could be adversely affected by project construction. However, the rattlesnake is more likely to avoid construction activities.

The blue sucker has the potential to occur in the Colorado River in the vicinity of the project area, but is not likely to be directly affected by construction activities since all construction will be located away from the river on higher elevations. There may be some indirect affects if soil erosion occurs on land freshly stripped of vegetation during construction and flows into the river during rains. However, the fish may avoid any local areas with higher levels of turbidity.

Migratory Birds

The bottomland hardwood forests in the project area are a declining resource and critical in the survival of neotropical migrating birds. The project will remove about 64.9 acres of this habitat during project construction, but will replace it with forest habitat of equal value and greater size in the mitigation plan. Therefore, project construction will temporarily remove some habitat used by migratory birds, but the habitat will be replaced and preserved in the long term during the life of the project.

Air Quality

Implementation of the Recommended Plan would result in a temporary reduction in forested area, which in turn could adversely affect air quality. However, in the long term the impacts would be offset due to the mitigation requirements.

There may also be minor temporary impacts to air quality due to construction equipment used during the construction activities. There would be increases in particulate matter as a result of fugitive dust particles. In addition, the exhaust from the construction equipment would result in temporary impacts to air quality. These impacts would be minor since Wharton County is not classified as a “Non-attainment” area.

There may also be temporary impacts by construction vehicles during the construction period. Fugitive dust would be controlled as necessary by best management practices to minimize this and other temporary construction impacts. Conformity analysis is not required as the construction site is not in a non-attainment area.

Hazardous, Toxic, and Radioactive Wastes

Based on the literature search conducted in April 2003, and the environmental site reconnaissance conducted in March 2005, no identified environmental sites are located in or near the proposed footprint of the project. Thus, there are no anticipated adverse impacts as a result of implementation of the Recommended Plan.

Noise

For on-site construction workers, the permissible exposure limits (PEL) and requirements for noise control are an 8-hour time-weighted average exposure level (TWA) of 90 dBA with a 5-

dB exchange rate between allowable duration and noise level. Engineering or administrative controls are required to be implemented above this level, and hearing protection devices (HPDs) must be issued and worn when exposures exceed the PEL. Regulations require hearing conservation programs (HCPs) for overexposed workers. The Occupational Health and Safety Administration's Construction Regulation 1926.101 mandates the use of hearing protection above the PEL and requires insert devices to be fitted or determined individually by ''competent persons" (Suter 2002). Table B-3 provides a summary of noise exposure levels experienced by heavy equipment operators. Heavy equipment such as backhoes, front-end loaders, and cement and dump trucks would cause short-term, localized, insignificant increases in noise levels. These short-term increases are not expected to substantially affect adjacent noise sensitive receptors or wildlife areas. Construction activities would increase noise levels temporarily at locations immediately adjacent to the project area, but would be attenuated by distance, topography, and vegetation. Noise levels created by construction equipment would vary greatly depending on factors such as the type of equipment, the specific model, the operation being performed, and the condition of the equipment. The equivalent sound level of the construction activity also depends on the fraction of time that the equipment is operated over the time period of the construction. Construction would occur only during daylight hours, thus reducing the DNLs and the chances of causing annoyances. The use of BMPs such as keeping equipment in good operating condition, proper training, and providing appropriate health and safety equipment will minimize the potential noise impacts associated with the proposed action.

Table B-3
Average Daily Noise Exposure Levels (8-hour TWA)
of Heavy Equipment Operators and Associated Laborers in dBA

Operator or Task	*Mean TWA*	*SD*	*Range*
Heavy-duty bulldozer	99	5	91-107
Vibrating road roller	97	4	91-104
Light-duty bulldozer	96	2	93-101
Asphalt road roller	95	4	85-103
Wheel loader	94	4	87-100
Asphalt spreader	91	3	87-97
Light-duty grader	89	1	88-91
Power shovel	88	3	80-93
Laborers	90	6	78-107
Crawler crane - .35 ton Noninsulated cab	97	2	93-101
Crawler crane - 35 ton Noninsulated cab Insulated cab	94 84	3 3	90-98 80-89
Rubber tired cane - 35 ton Noninsulated cab Insulated cab	84 74	5 9	78-90 59-87
Rubber tired crane - 35 ton Insulated cab	81	4	77-87
Truck-mounted crane	79	2	76-83
Tower crane	74	2	70-76

OTHER SOCIAL EFFECTS

Socioeconomic Resources

Overall, there would be positive and negative effects to socioeconomics as a result of implementation of the recommended plan. There would be long term annual savings from the reduction in flood damages to public and privately owned properties occurring in Wharton. In addition, the city would save money on cleanup costs. There would also be short-term

employment effects associated with the with-project construction that would stimulate increased demand locally for construction materials and services. These expenditures would be expected to result in a positive multiplier effect on the local community and would last for the period of construction, which is estimated at 24-months. There would be a negative reduction in local tax base as a result of taking property off of the tax roles and putting it into public ownership. The biggest direct benefit to the residents, however, is the elimination of the need to maintain flood insurance policies. The amount of this savings varies, but it can be as much as several thousand dollars per year for a typical homeowner. There would be minor negative impacts and overall positive benefits for implementation of the Recommended Plan on socioeconomic resources.

Traffic

There would be temporary impacts to traffic as a result of implantation of the Recommended Plan. Construction equipment would cause minor increases in traffic inconveniences, but since traffic is so minimal in the town, these impacts would be minor. As a result of project construction Polk Street from Caney to Elm Street would be closed while project features are placed within the road right-of-way. The road would be reopened after project construction.

Public Health and Safety

There would be a positive benefit to public heath and safety as a result of implementing the Recommended Plan. The proposed project would provide 1% ACE flood protection to almost the entire city of Wharton. This would reduce the risk and hazards associated with flooding in Wharton. There would be no adverse impacts associated with project implementation.

Public Services

There would be a benefit to public services as a result of implementation of the Recommended Plan. The strain on public resources associated with emergency services and cleanup would be reduced. There would be no adverse impacts to public services as a result of project implementation.

Cumulative Impacts

The subject of cumulative impacts, as it pertains to all known potential future actions within the Lower Colorado River Basin, has previously been addressed on the report titled *Final Programmatic Environmental Impact Statement, Flood Damage Reduction and Ecosystem Restoration, Lower Colorado River Basin, Colorado River, Texas,* dated August 2005 (PEIS). Project features within the proposed Wharton flood damage reduction study were evaluated within this PEIS.

Of particular interest is the hydrologic impacts, and the cumulative relationship between the proposed Wharton flood damage reduction project, and the Lower Colorado River/San Antonio Water System (SAWS) Project. While the SAWS project is still in the early planning stages, the concept of the project is to capture excess flood flows into off-channel storage areas. The peak capture rate may approach several thousand cubic feet per second. As noted earlier, an adverse impact of the Wharton project is that during passage of flood events with magnitudes between the 2% and 1% exceedence (50-year and 100-year) events, flow rates on the Colorado River are increased by several thousand cubic feet per second. In essence, these two projects will essentially cancel themselves out in terms of flow rate changes for these events, resulting in little to no changes downstream of Wharton.

There would be a potential cumulative beneficial impact to the economy from the increased potential for development as a result of the Recommended Plan. The project was not designed to allow for additional development; however, since most of the city would be protected from a 1% ACE event, some lands that were not available for development because of their location in the flood zone, may be able to be developed after project construction. This would increase the tax base of the county and the city. Exact properties were not identified, but the potential is likely. The construction that may occur would more than likely result in the loss of additional fish and wildlife habitat. However, existing wetlands would still be regulated under the Clean Water Act and any impacts would have to be permitted. This benefit would be minimal because there is already plenty of existing developable lands that are not being developed, so just because more land is available does not guarantee that it would ever be developed.

Environmental Mitigation

The mitigation plan was developed with the help of USFWS and TPWD personnel who participated in collecting the field data to run the HEP analysis and provided valuable advice in completing the analysis. During coordination on where mitigation was to be located, these agencies stated a strong preference for acquiring some of the bottomland hardwood habitat found at two alternative sites located along the Colorado River just outside the levee system. Both agencies would like to see this land preserved as part of the Austin's Woods (Columbia Bottomlands) Conservation Plan, which could be administered by the Nature Conservancy or as part of the Brazoria National Wildlife Refuge Complex (USFWS, 1997). However, a full analysis described below indicates that compensatory mitigation can be achieved on project lands eliminating the need to purchase any lands outside the project for preservation. Utilizing project lands would also be the most cost effective means to develop required environmental mitigation.

Although preservation of these ecologically sensitive and disappearing bottomland hardwoods is a high priority goal of the resource agencies and one that may be needed to ensure survival of migratory neotropical birds, the USACE must follow its guidance in ER 1105-2-100. One of the principal requirements for complying with this guidance is the need to demonstrate that damages to significant ecological resources (wetlands and bottomland hardwood forests) have been avoided or minimized to the extent practicable and that unavoidable damages to these resources have been compensated to the extent justified. The guidance also requires that habitat-based analyses be used to determine the amount of mitigation needed to appropriately compensate for project impacts.

Minimization of project impacts was obtained by locating levees inside the urban area, to the extent practicable, where resources have already been impacted and relocating the sumps, as much as possible, to avoid forests and high quality wetlands. The remaining impacts to wetlands and riparian bottomland forests are unavoidable and will be fully compensated as described below.

To mitigate for the unavoidable impacts identified in Table B-2, a project-specific mitigation plan was developed that satisfied the USACE's incremental analysis requirements in ER 1105-2-100. The plan considered the quality and regional significance of the impacted habitats and focused on mitigating impacts to high-quality habitat while minimizing additional land acquisition costs.

ER 1105-2-100 also provides special requirements for riparian/hardwood forests in that adverse impacts are to be mitigated in-kind, to the extent possible, so that the forest is mitigated as an ecological system rather than mitigating for faunal species. Although a Habitat Evaluation Procedure (HEP) using several evaluation species as an indicator of habitat quality was used in this analysis rather than an ecosystem model, the USFWS and TPWD agreed that this procedure

was acceptable given the short time available to model the system. Both agencies participated in selecting the evaluation species for each habitat to be modeled and helped collect data to run the model. The evaluation species were selected to represent the species expected to occur in the study area and the habitat being evaluated.

For project impacts to wetlands, ER 1105-2-100 states that after avoidance and minimization, unavoidable losses will be fully compensated (mitigated) to meet the administration's goal of no net loss of wetlands. Again, HEP was used to measure the quality and quantity of the natural and created wetlands in the project area to determine how much compensation is needed to offset the losses due to project construction.

Alternative Mitigation Sites

In addition to consideration of conducting environmental mitigation on project lands, three addition sites were evaluated. These sites are referred to as "The Borrow Site", the "Harrison Tract", and "Pierce Ranch". Characteristics of these sites, including restrictions to use of these sites for environmental mitigation, are discussed in this section.

The Borrow Site

This site is located on the north side of the Colorado River south of the Ford St. Sump and between the city landfill and the Kansas City-Southern railroad. Most of the riparian forest that once existed at the 33-acre site was removed so that the underlying sand could be stripped and sold as fill material. Only a remnant 7 acre tract of the original forest remains along the river bank that appears to consist mostly of cottonwoods, black willow, and some native pecans. A brief reconnaissance of the site was completed from the roadside on 29 June 2006. A pedestrian survey was not permitted, so a description of the site is limited to the area near the road and aerial photos from 2004.

The disturbed area has revegetated with numerous Chinese tallow, huisache, and native pecans from 10 to 15-feet tall. This area could be improved by removing the invasive Chinese tallow and huisache and replanting it with a selection of trees from the list provided in Table B-10. The site would have to be managed over the 50-year period of analysis by periodically removing the Chinese tallow, huisache, and other invasive species in order to maintain habitat quality. Cattle could be allowed to graze in the area to help control low-growing vegetation. Otherwise, the site would be permitted to develop naturally.

Table B-4 shows the baseline HSI values and HU's for the evaluation species in each of the three alternate sites considered for the mitigation plan. As expected, the Borrow Site has the lowest habitat quality of all the sites and would provide the most benefits if it were acquired for the mitigation plan. It is possible that the site could be improved over the 50-year analysis to provide habitat quality between 0.8 and 1.0 HSI for three of the four evaluation species and perhaps as much as 0.6 for the downy woodpecker. However, the 26-acre site does not have enough area to provide the AAHU's needed to mitigate the loss of 64.9 acres of forest habitat. Additional land would be needed to complete the mitigation requirements.

It is not known whether the landowner of this site would be a willing seller, but since the site is not being used for any other purpose than a source of fill material, the potential for acquiring the area appears to be high.

Table B-4
Baseline HSI values and HU's for evaluation species for forest habitat in each of the three alternative mitigation sites outside the sumps

Evaluation Species	Area of Available habitat (Acres)	Average HSI Value	Habitat Units
Borrow Site			
Raccoon	26	0.1	2.6
Barred Owl	26	0	0
Fox Squirrel	26	0	0
Downy Woodpecker	26	0	0
Harrison Tract			
Raccoon	44.9	0.6	26.9
Barred Owl	44.9	0.4	18.0
Fox Squirrel	44.9	1.0	44.9
Downy Woodpecker	44.9	0.1	4.5
Pierce Ranch			
Raccoon	128.5	0.9	115.7
Barred Owl	128.5	0.4	51.4
Fox Squirrel	128.5	1.0	128.5
Downy Woodpecker	128.5	0.45	57.8

Harrison Tract

This 45-acre site is located in an east-west trending river bend west of the city landfill and south of the Hughes St. Sump. The site is used as a pasture and had cattle and a couple of donkeys grazing on it at the time of the visit on 29 June 2006. The land is mowed periodically to maintain the pasture and prevent shrub and tree invasion, particularly near the river. Very little dead timber was found on the site, either as standing trees or deadfall.

The northeast edge of the site is populated with hackberry about 20-30 feet tall and native pecans about 30-40 feet tall. In the middle of the site, the trees are larger and scattered over the pasture land, allowing open areas for cattle grazing. Even with an average 50-100 foot spacing between the trees, the 50-60 foot tall native pecans had a canopy closure approaching 50%. There were clumps of smaller trees scattered around the pasture and along the fence rows consisting of downy hawthorn, Vaccinium sp., and cedar elm. Cottonwoods, black willow, and cedar elm were found closer to the river and several plum trees (Prunus domestica) were noted. The pasture was a mixture of Bermuda grass, Johnson grass, Croton sp., and Carex sp. A patch of giant cane (Arundinaria gigantean) was found on the south side of the site along the river bank.

Because there is a mixture of mature riparian and bottomland hardwood habitat, open field, and wetland habitat along the river bank that provides good habitat diversity, it is doubtful that any additional plantings could provide enough additional habitat units in the first 10 years to make a significant difference in the mitigation credits. It would be best to preserve the site as it is and stop mowing the area to allow more shrubs and tree seedlings to grow and more snags to develop in the forest. Periodic inspections and removal of undesirable species would be needed to prevent Chinese tallow and huisache from invading.

An estimate of the baseline HSI values for this site ranges from 0.1 (downy woodpecker) to 1.0 (fox squirrel). The habitat quality for the downy woodpecker would increase if the pasture was not maintained and new trees were allowed to grow to increase refuge sites, canopy cover,

and basal area of woody vegetation. However, with an area of 44.9 acres, the site could not generate enough AAHU's to fully compensate for forest habitat lost to project construction.

However, there is the potential the site could be converted to cropland, but a realistic prediction of when this would occur is not possible. City officials state that this landowner is not likely to change the use of this land and would be an unwilling seller if this alternative was selected as part of the mitigation plan. Therefore, the land would have to be acquired through condemnation.

Pierce Ranch

This site is the largest of the alternatives identified outside the flood protection area. It is a 128 acre site located in a large east-west trending river bend east of Hwy. 59, north (upstream) of the Harrison Tract (Site 2) and south of and across the river from the Nanya Plastics Sump. A pedestrian survey of the area was not permitted, but 2004 aerial photos showed the site has habitat similar to but of higher quality than that found in the Harrison Tract. The site consists of two open fields of about 7 and 14 acres that may be used for cattle grazing, another 14-acre area that appears to be vegetated with shrubs or small trees, a sandy overflow channel for the river that crosses near the tip of the bend and may contain cottonwoods and black willow, and thick to sparse patches of large trees (probably pecans) covering the remainder of the site. Immediately south of the mitigation site, extending east from Hwy. 59 and paralleling the river is a large agricultural field planted in row crops.

This site appears to have the most diverse mix of bottomland hardwood habitat of all the sites in the area. Table 10 shows habitat quality varies from 0.4 to 1.0 for the evaluation species. There does not appear to be enough potential for improvement at this site to increase its habitat value to compensate for the habitat lost to project construction. The best use of the site is preservation and managing the site as it exists today.

There is the potential the site could be converted to cropland as has happened in the area immediately to the south, but there is no way to realistically determine when this would happen. Residential or industrial development of the site is unlikely due to periodic flooding. Therefore, if this site is not converted to another use within the 50-year period of analysis (FWOP condition), it would be necessary to combine this site with the other two sites above in order to gain enough mitigation credits to offset project losses. However, city officials state the owner of the Pierce Ranch would be an unwilling seller of any part of their land. Therefore, it would require condemnation to acquire the property.

Sumps as a Proposed Mitigation Alternative

Mitigation for wetland impacts could be located in several of the larger sump areas where adequate room provided space for planting native wetland vegetation and forests to provide reproductive habitat for the evaluation species. Sumps that were considered for a mitigation site include Wal-Mart (Figure B-9), Nanya Plastics (Figure B-10), Hughes St. (Figure B-11), Alabama St. (Figure B-12), Baughman Slough Railroad (Figure B-13), and Baughman Slough Ahldag (Figure B-14). The advantage to using the sumps for wetlands is that they can be used at no additional real estate acquisition cost to the project and they are designed to collect storm water and can retain a portion of it for the wetland habitat.

Mitigation for riparian/hardwood forests could also be located in the sumps for cost savings. Should there be further identified need for forest mitigation, alternative properties as previously discussed could be considered. The additional sites, if needed, would be acquired at additional project cost.

Grassland impacts were quantified in order to provide complete information on project impacts for decision-makers and the public. However, since this habitat is managed loclly for pastureland, contains very little, if any, native prairie vegetation, and is not locally, regionally, or nationally scarce, it will not be mitigated. The areas that will be identified later for storing excess material excavated from the sumps will be located on grasslands to avoid additional mitigation requirements and the stockpiled material will be seeded with native grasses to restore the area to a condition similar to the native prairie habitat that once existed in the area.

A Habitat Evaluation Procedure (HEP) was used to determine the amount of mitigation needed to compensate for project impacts. The HEP uses evaluation species as an indicator of habitat quality by determining a Habitat Suitability Index (HSI) for each species using the habitat. The number of habitat units (HU) available in the habitat is calculated by multiplying the HSI by the area of habitat being analyzed. The final step in the process is to project the condition of the habitat into the future over the period of analysis and determine what the value of the habitat will be at certain points in time (target years) when a change in habitat conditions is likely to occur and then sum up the HU's for each species and divide by the years in the period of analysis. This provides the average annual habitat units (AAHU's) that can be compared to the AAHU's calculated for the same habitat type and evaluation species at different locations or different conditions (management plans) at the same location.

Once the existing (baseline) quality of a habitat (HSI values) has been calculated for each species, the next step in determining project changes to each habitat is to calculate the Future Without Project (FWOP) conditions, then the same process is repeated to calculate the Future With Project (FWP) conditions. The difference between these two conditions can be used to calculate the mitigation needed to compensate for habitat lost for each of the evaluation species. It must be remembered that for this project the focus of this mitigation is to replace the forest with another forest of nearly equal value using the evaluation species only as surrogates for quantifying habitat quality. No attempt will be made to replace the habitat for each evaluation species.

The assumptions and procedures used to calculate the average annual habitat units (AAHU) for the FWOP and FWP conditions are described below.

Quantification of Mitigation

Because there will be no project-related direct or indirect impacts to the habitat outside the construction areas at the levee, sump, and drainage features, a straightforward approach was used to determine changes in habitat units for forest, grassland, and wetland habitats. Only the area of habitats that will be removed during construction will be used in the HEP analysis and will be counted for mitigation, where appropriate. Using these assumptions, a total of about 64.9 acres of riparian/hardwood forest, 128.6 acres of grassland, and 9.9 acres of wetland habitat will be removed during construction (Table B-2).

Four evaluation species (raccoon, barred owl, fox squirrel, and downy woodpecker) were used to calculate the quality of the forest habitat. Two different forested areas were surveyed (Wal-Mart Sump and Nanya Plastics Sump) because they represented the range of habitat quality in the area. The urban forested areas, however, more closely match the Wal-Mart Sump forest in species composition, size of trees, and canopy cover. Because there are some differences, it is assumed that the best estimation for Habitat Suitability Index (HSI) values over

all forest habitat types is an average of the scores for the Wal-Mart and Nanya Plastics forests. It is also recognized that the wildlife use of the urban forest habitats is much more restricted than occurs in the two reference forests. Additionally, since the urban forest habitat is very small compared to the Wal-Mart and Nanya Plastics forests, it is doubtful that any difference in quality is meaningful.

The forest at the Wal-Mart and Nanya Plastics Sumps were surveyed on 15 June 2006 for the habitat variables used in calculating HSI values for the evaluation species. The forest at the Wal-Mart Sump was open and used for cattle grazing. Because the area was mowed to control vegetation, shrubs and small trees were restricted to the base of the large trees. The dominant tree was the native pecan which accounted for about 90% of the trees and averaged 30-40 feet in height. An understory was lacking, except around the pecan trees. Species in the understory included wooly buckthorn, hackberry, and cedar elm from 8-12 feet tall. Bermuda grass made up 95% of the grass in the forest and adjacent pasture.

The forest at the Nanya Plastics Sump was mixed habitat of riparian forest, some open field, and fence row. There were some large pecans scattered across the area, some of which approached 75 feet in height. There was an abundance of hackberry and wooly buchthorn to 20 feet tall and a mixture of hawthorne, parsley, and viburnum along the fence rows. Vegetation in the open field consisted of croton, Johnsongrass, huisache, Bermudagrass, and sedge.

The riparian habitat in the Nanya Plastics sump differs from the Wal-Mart forest in that it has a smaller percentage of mature trees, a higher diversity of species, a higher number of trees per acre, and more snags for reproduction for some of the evaluation species used in the analysis. The higher diversity and lower average age of the trees is due to the lack of cattle grazing and pasture management compared to the Wal-Mart Sump, both of which would reduce the amount of understory and brush, and the past use of the site for borrow material for construction projects. It appears from 1995 aerial photos that much of the site may have been cleared for borrow material as early as 1990.

Three evaluation species (raccoon, wood duck, and green heron) were used to calculate the quality of the wetland habitat. Two different wetland sites were surveyed initially, both of which were located in the Nanya Plastics Sump. One appears to be an old ox-bow pond that has the highest quality habitat in the project area outside the Colorado River and its banks. The HSI values for this habitat were later dropped from this analysis because it was determined the Nanya Plastics Sump could be positioned such that this wetland area would not be needed and, therefore, would not be affected. As a result, only the lower quality habitat represented by the small pond which was created by local drainage flowing into the bottom of a borrow pit, as well as from a ditch that also retains some water in a short section before it empties into the borrow pit, will be used as a surrogate for the other wetlands that will be impacted by levee crossings, sump excavation, channel improvement, and ditching. The habitat quality of most of the other wetlands (e.g., those found in Baughman Slough) is lower since they tend to be ephemeral and lacking nearby forest to provide reproductive habitat and cover for the evaluation species and their young (e.g., the wood duck). However, it is assumed these differences in habitat quality will not be meaningful since the total area of these wetlands is small.

The grassland habitat was evaluated for habitat quality using three evaluation species (red-tailed hawk, meadowlark, and scissor-tailed flycatcher), but this habitat is not considered a candidate for mitigation as explained above. It should be noted that the red-tailed hawk is a multiple-habitat user and depends on the grasslands for food and nearby forests for reproduction. Since this species is used as an evaluation species only for grasslands, only the HSI value for the food component of the model is used in the HEP analysis.

Future Without Project

Table B-5 provides the average baseline condition HSI values and habitat units (HU) for each evaluation species in each of the three habitats. The average HSI value was obtained by averaging the HSI values for each of the three sump areas that were evaluated with the help of the USFWS. Before a calculation of AAHU's can be done using the HU's in Table 4, a decision must be made on when a change will occur in the quality or quantity of each habitat over the designated period of analysis (50 years for this project).

Table B-5
Average HSI values and HU's for Evaluation Species for all habitats in the project impact area under Baseline Conditions

Evaluation Species	Area of Available habitat	Average HSI Value	Habitat Units
Forest			
Raccoon	64.9	0.85	55.2
Barred Owl	64.9	0.34	22.1
Fox Squirrel	64.9	0.89	57.8
Downy Woodpecker	64.9	0.28	18.2
Wetland			
Raccoon	9.9	0.46	4.6
Wood Duck	9.9	0.18	1.8
Green Heron	9.9	0.59	5.8
Grassland			
Red-tailed Hawk	128.6	0.27	34.7
Meadowlark	128.6	0.45	57.9
Scissor-tailed Flycatcher	128.6	0.81	104.2

When determining the target years for the FWOP condition the HEP analysis based on changes that might occur in habitat quantity and quality, it was assumed for the forest habitat that there will be no meaningful changes in habitat quality (tree removal) since there is little potential for future development without flood protection. The local economy is based primarily on agriculture and will likely continue as such in the foreseeable future. An assumption of little change in the quality of the habitat is based also on the fact that the dominant tree species in all of the forests in the project area is the native pecan which is a long-lived species. Most of the pecan trees in the Wal-Mart site are 30-50 feet tall and possibly 40-50 years old. There is little likelihood that these trees will be removed from the pastures or fields by the owners and they could easily thrive for another 50 years. Any natural losses will be insignificant; therefore, the habitat quality (HSI) is not likely to change. Also, the ground around the trees is mowed to maintain the pasture or any recreational value (urban areas), which prevents successional changes from occurring. However, there is the potential that some of the trees inside the city could be removed for various reasons, such as new infrastructure (roads, sewers, and power lines), some minor flood control measures (new ditches) by the city, and some new homes added or modified as neighborhood demographics change. This change will probably be gradual and will not affect a large area of forest, but it is assumed for the purposes of this analysis that the urban forest in the Ford St., Sunset St., Black/Collins St. Sumps, and the Storage Drain areas will be lost about 30 years into the 50-year period of analysis. As evidence for this, the City is already constructing the Sante Fe Ditch in advance of project construction to relieve some local flooding now and will probably continue to make other minor improvements as funding from the local tax base becomes available, if the proposed project is not built.

The same assumption (no change in habitat values for each evaluation species) also applies to the grassland habitat. Most of the grasslands are maintained as pastureland or for recreational/aesthetics purposes in the city, which prevents any successional change. Moreover, it is doubtful there will be any meaningful change in the area of grasslands, given the fact there is so little of this habitat inside the city. However, for consistency, it is also assumed that the grasslands inside the city will be lost to various human activities, as noted above for the forest habitat. It is assumed that all grasslands in the Ford St., Sunset St., and a portion of the Black/Collins St. Sumps will be removed. The Alabama St. Sump has no grassland, except in the ditch on the north side of the site, since it is all cropland and ditch. It is also assumed this loss will be complete by year 30 in the period of analysis.

Finally, for the wetland habitat, the assumption of no change in habitat values for each evaluation species is used for the few, generally low-quality wetlands that will be impacted. Due to their small size and location outside the urban environment, for the most part, it is assumed that there will be no loss in this habitat. There is the potential for more borrow activity to occur in the borrow pit at the Nanya Plastics site, but a realistic expectation and prediction of this occurrence happening at a specific target year is not possible. Because there is so little area involved in the Nanya Plastics site, this potential will be discounted. The other patches of wetlands that the levees will cross are not likely to have any meaningful change in size or value due to mowing and grazing, and the lack of development pressure in agricultural fields, and flooding in the urban area.

Table B-6 provides the target years and area of impact for the FWOP condition based on the assumptions described above.

Table B-6
Future Without Project target years and impact area
for each habitat in the construction areas

Habitat	Target Year	Area (Acres)
Forest	Baseline	64.9
	1	64.9
	30	62.2
	50	62.2
Wetland	Baseline	9.9
	1	9.9
	30	9.9
	50	9.9
Grassland	Baseline	128.6
	1	128.6
	30	124.8
	50	124.8

The final step in calculating the average annual habitat units (AAHU) for each habitat is to calculate the habitat units (HU) contained in a habitat for each evaluation species at each target year and then sum all the HU's to get the cumulative HU's. The cumulative HU's are then divided by the period of analysis (50 years) to get the AAHU's which can be compared with similar habitats in a mitigation plan to ensure adequate compensation for project impacts (losses). Table B-7 presents the HU's calculated for each evaluation species in each habitat, the cumulative HU's of all the evaluation species in a habitat, and the AAHU's.

Table B-7
Evaluation species for each habitat found in the project construction areas, the habitat units, and average annual habitat units for each habitat in the FWOP analysis

Habitat	Species	Target Years Compared	Habitat Units Between TY	Average Annual Habitat Units
Forest	Raccoon	$T_1 - T_0$	55.2	
		$T_{30} - T_1$	1,557.3	
		$T_{50} - T_{30}$	1,046.0	
	Barred Owl	$T_1 - T_0$	22.1	
		$T_{30} - T_1$	626.4	
		$T_{50} - T_{30}$	422.0	
	Fox Squirrel	$T_1 - T_0$	57.8	
		$T_{30} - T_1$	1,641.4	
		$T_{50} - T_{30}$	1,108.0	
	Downy Woodpecker	$T_1 - T_0$	18.2	
		$T_{30} - T_1$	516.2	
		$T_{50} - T_{30}$	348.0	
Cumulative Habitat Units			**7,418.6**	
AAHU				**148.4**
Wetland	Raccoon	$T_1 - T_0$	4.6	
		$T_{30} - T_1$	133.4	
		$T_{50} - T_{30}$	92.0	
	Wood Duck	$T_1 - T_0$	1.8	
		$T_{30} - T_1$	52.2	
		$T_{50} - T_{30}$	36.0	
	Green Heron	$T_1 - T_0$	5.8	
		$T_{30} - T_1$	168.2	
		$T_{50} - T_{30}$	166.0	
Cumulative Habitat Units			**610.0**	
AAHU				**12.2**
Grassland	Red-Tailed Hawk	$T_1 - T_0$	34.7	
		$T_{30} - T_1$	991.8	
		$T_{50} - T_{30}$	674.0	
	Meadowlark	$T_1 - T_0$	57.9	
		$T_{30} - T_1$	1,653.0	
		$T_{50} - T_{30}$	1,124.0	
	Scissor-Tailed Flycatcher	$T_1 - T_0$	104.2	
		$T_{30} - T_1$	2,975.4	
		$T_{50} - T_{30}$	2,022.0	
Cumulative Habitat Units			**9,637.0**	
AAHU				**192.7**

The table shows that without the project in place, the forests will retain a habitat value of about 148.4 AAHU's for all of the evaluation species over the 50-year period of analysis. The wetlands will have a value of about 12.2 AAHU's and the grasslands will have a value of about 192.7 AAHU's.

Future With Project

The next step in the HEP analysis for the project is to calculate the AAHU's for each habitat with the flood damage reduction project in place. Because the analysis is done only in the construction areas (levees, sumps, channel improvements, and drainage ditches) which will remove all surface features (habitats), it should be no surprise that the AAHU's for this condition will be very low. There are only three target years (TY) needed for FWP analysis: Baseline (TY_0), TY_1 when project construction ends, and the final TY_{50} at the end of the period of analysis. There are no intermediate TY's because the habitat will not recover with the project features in place. The AAHU's are calculated using the same formula as in the FWOP analysis and the results are presented in Table B-8.

Table B-8
Evaluation species for each habitat and the habitat units and average annual habitat units for each habitat in the Future With Project analysis

Habitat	Species	Target Years Compared	Habitat Units Between TY	Average Annual Habitat Units
Forest	Raccoon	$T_1 - T_0$	27.6	
		$T_{50} - T_1$	0	
	Barred Owl	$T_1 - T_0$	11.1	
		$T_{50} - T_1$	0	
	Fox Squirrel	$T_1 - T_0$	28.9	
		$T_{50} - T_1$	0	
	Downy Woodpecker	$T_1 - T_0$	9.1	
		$T_{50} - T_1$	0	
Cumulative Habitat Units			**76.7**	
AAHU				**1.5**
Wetland	Raccoon	$T_1 - T_0$	2.3	
		$T_{50} - T_1$	0	
	Wood Duck	$T_1 - T_0$	0.9	
		$T_{50} - T_1$	0	
	Green Heron	$T_1 - T_0$	2.9	
		$T_{50} - T_1$	0	
Cumulative Habitat Units			**6.1**	
AAHU				**0.12**
Grassland	Red-Tailed Hawk	$T_1 - T_0$	17.4	
		$T_{50} - T_1$	0	
	Meadowlark	$T_1 - T_0$	29.0	
		$T_{50} - T_1$	0	
	Scissor-Tailed Flycatcher	$T_1 - T_0$	52.1	
		$T_{50} - T_1$	0	
Cumulative Habitat Units			**98.5**	
AAHU				**2.0**

As expected, with project implementation the average annual habitat quality is greatly reduced compared to the without a project condition. The AAHU's for the Future with a project conditions range from 0.12 for the wetland habitat to 1.5 for the forest habitat and 2.0 for the grassland habitat.

Proposed Mitigation Plan

To determine how much new habitat is needed to compensate for project impacts to riparian/hardwood forests and wetlands, the AAHU's for each habitat in the FWP are subtracted from the AAHU's for each habitat in the FWP. Based on this calculation, the approximate AAHU's, which are all negative, needed in the new habitats to offset project losses are:

- Riparian/Hardwood Forests: 146.9
- Wetlands: 12.1

Incremental Cost Analysis

As mentioned earlier four different alternatives were considered for the mitigation plan that would be used in an incremental cost analysis. These consisted of:

(1) Mitigation in the Sumps: Mitigation for forest habitat would be located in 8 of the 9 sumps and in the Baughman Slough channel improvement area and for the wetland habitat in 6 of the 9 sumps.
(2) Mitigation Site 1 (Borrow Site): Mitigation for forest habitat only would be located on a 26-acre portion of the 33-acre site.
(3) Mitigation Site 2 (Harrison Tract): Mitigation for forest and some of the wetland habitat would be located on a 44.9-acre site.
(4) Mitigation Site 3 (Pierce Ranch): Mitigation for forest and some of the wetland habitat would be located on a 128.5-acre site.

In Alternative 1, all habitat mitigation can be provided on project lands. Land needed for mitigation would be acquired as part of the project to construct project features and would not be an additional cost to the project. After construction, as much as 144.9 acres could be used to create replacement forest, shrub, and native prairie habitat, and as much as 39.9 acres could be used to create replacement wetland habitat. There would be no land costs included in this estimate since the land must be acquired for project construction. Wetland construction costs would be minimal because the sumps would be excavated as a project feature. The drains for the sumps would be elevated to retain at least 2 feet of water to create the wetlands.

The last three alternative plans would require purchase of lands at additional cost to the project. Also, none of the three sites would provide sufficient mitigation credits by themselves to fully compensate for the project-related loss of forest and wetland habitat, unless sites 3 and 4 are converted to cropland or other use that requires removing the forest early in the period of analysis. Another concern is that none of the three alternative sites outside the flood-protection area, with the possible exception of the Pierce Ranch, could provide enough area for wetland construction without reducing forest size and the AAHU's they provide. Therefore, all three sites would have to be acquired to provide full compensation for habitat losses in the project.

Land costs in this area are estimated to be in the range of $4,000 to $5,000 per acre, if there is a willing seller. Since two of the landowners are known to be unwilling sellers, the land would have to be acquired through condemnation and the land cost could be much higher. Regardless of how the land is acquired, if an average cost of $5,000/acre is applied to the area in these three sites, the total purchase price would be about $1,035,000. The cost of planting trees and shrubs on the 26-acre site in Alternative 2 would be about $208,000. The other two sites would be preserved and no additional tree planting would be necessary. Assuming that a total of about 39 acres of wetlands are excavated to a depth of about 3 feet to ensure a permanent supply with at least 12-inches of depth and wetland plants are introduced at the two largest sites, the cost of this mitigation alternative could easily reach $3,000,000 to $4,000,000.

Based on the cost analysis for each of the four alternatives described above, it is evident that constructing all forest and wetland mitigation habitat on project lands is the most cost effective of the mitigation alternatives and is, therefore, the recommended environmental mitigation alternative. Based on this conclusion, an incremental analysis of the various sump areas was conducted to determine which sumps would be the most cost effective and incrementally justified.

The USACE proposes to compensate for project losses by recreating as much of the habitat as possible on lands acquired for construction of project features to reduce real estate costs. The proposed sites for the mitigation features are the sumps, which are required by the project to collect storm water during local floods. Table B-9 presents the maximum area available for each mitigation habitat in each of the sumps.

Table B-9
Area available for forest and wetland habitat in each sump

Sump	Forest (acres)	Wetland (acres)
Wal-Mart	24.6	6.6
Nanya Plastics	30.4	9.8
Hughes St.	38.5	2.7
Ford St.	3.3	0
Sunset St.	0	0
Black/Collins St.	3.8	0
Alabama St.	7.6	2.5
Baughman Slough – Railroad	25.7	8.3
Baughman Slough – Ahldag	4.0	10.0
Baughman Slough – Channel Bench	7.0	0
Total	**144.9**	**39.9**

Forest Mitigation

Table B-9 shows that a maximum of about 144.9 acres are available in the sumps for planting a mixture of tree species to compensate for project losses. The maximum available area was used in the HEP analysis because it was not known how much area would be required to fully mitigate the project losses. The Sunset St. Sump will not be considered for any habitat replacement because it is too small to offer any meaningful habitat value for wildlife. To determine the AAHU's the mitigation forest contains, certain TY's representing the time of expected change in habitat value are needed to measure the gains in habitat value over the 50-year period of analysis. The habitat gains will be reflected in habitat units calculated for each evaluation species as the trees and wetland vegetation mature. Table B-10 presents a list of trees, shrubs, and wetland vegetation that can be planted in each sump. This list may be modified before construction after additional consultation with the resource agencies and comments from the public during the review period.

Table B-10
Types of trees, shrubs, and wetland vegetation proposed for planting in the mitigation sites

Trees and Shrubs	Wetland Plants
Water Oak	Smart Weed
Willow Oak	Common Rush
Pecan	Sedge
Hackberry	Pickerel Weed
Water Hickory	Spider Lily
Green Ash	Arrowhead
Wax Myrtle	Rose-Mallow
Sweet Gum	
Tupelo Gum	
Bald Cypress	
Yaupon	
Button Bush	

Scales for Woodland Measure

Seedlings

Under this scale the size of the trees would consist to .5 to 1 inch caliper saplings approximately 2-4 feet tall. They would be planted at a density of 200 trees per acre on about 14-foot centers. Tree mortality for this size is expected to approach 30-40% over the 50-year period of analysis.

Shrubs would be planted at the rate of 200 per acre using plants in flat containers at the rate of about 4 plants around the base or near a tree. This will retain some open ground between trees that is needed by some of the evaluation species and other forest animals and still contribute to cover needed by others. At this rate of planting, only about 25% of the trees would have shrubs around them, but it is expected that volunteers would be brought in from outside sources (animals and wind) to help colonize the area. Additional shrubs may be planted around the perimeter of the ponds to establish cover for wildlife using the wetlands. Details will be coordinated with the resource agencies. A more extensive list of shrubs and planting and management details will be provided during detailed planning for the mitigation construction.

1" Caliper

The size of the trees would consist of 1.5 – 2 inch caliper plants approximately 5-7 feet tall. They will be planted at a density of 50 trees per acre on about 30-foot centers. Although more expensive, this size and density of plantings will ensure a faster recovery of habitat value and lower mortality than would be achieved with less expensive seedlings. Tree mortality for this size tree is expected to approach 25% over the 50-year period of analysis, with most mortality occurring within the first 5 years of planting.

Shrubs will be planted at the rate of 50 per acre using plants in 1-gallon containers at the rate of about 4 plants around the base or near a tree. This will retain some open ground between trees that is needed by some of the evaluation species and other forest animals and still contribute to cover needed by others. At this rate of planting, only about 12 of the 50 trees will have shrubs around them, but it is expected that volunteers will be brought in from outside sources (animals and wind) to help colonize the area. Additional shrubs may be planted around the perimeter of the ponds to establish cover for wildlife using the wetlands. Details will be

coordinated with the resource agencies. A more extensive list of shrubs and planting and management details will be provided during detailed planning for the mitigation construction.

2" Caliper

The size of the trees would consist of 2 – 3 inch caliper plants approximately 10-12 feet tall. They will be planted at a density of 40 trees per acre on about 33-foot centers. Although more expensive, this size and density of plantings will ensure a faster recovery of habitat value. Tree mortality for this size tree is expected to approach 20% over the 50-year period of analysis, with most mortality occurring within the first 5 years of planting.

Shrubs will be planted at the rate of 40 per acre using plants in 5-gallon containers at the rate of about 4 plants around the base or near a tree. This will retain some open ground between trees that is needed by some of the evaluation species and other forest animals and still contribute to cover needed by others. At this rate of planting, only about 25% of the trees will have shrubs around them, but it is expected that volunteers will be brought in from outside sources (animals and wind) to help colonize the area. Additional shrubs may be planted around the perimeter of the ponds to establish cover for wildlife using the wetlands. Details will be coordinated with the resource agencies. A more extensive list of shrubs and planting and management details will be provided during detailed planning for the mitigation construction.

A review of the variables that influence habitat quality for the four forest evaluation species revealed that the most important variables common to most of the species are:

- Number of trees/acre greater than or equal to 20 inches diameter at breast height (dbh)
- Percent tree canopy closure varying from 40-60% (hard mast) to 60% or more
- Distance to water (0.5 mile or less)
- Number of snags and refuge sites for reproduction or sanctuary, with 4 or 5/acre the best.

Assumptions for Habitat Evaluation and Future with Project Woodland Mitigation

These variable were used to identify the TY's in the HEP analysis. One variable, distance to water, can easily be optimized in most of the sumps since wetlands will be provided in all, except the two smallest sumps with tree plantings: Ford St. and Black/Collins St. Sumps. The other three variables depend on forest maturity to reach maximum values for quality. The values will increase as the trees grow in diameter and canopy cover increases as tree crowns increase in size. Growth is highly variable between species and even between individuals of the same species, but it is not unreasonable to expect some of the faster growing trees, such as the oaks, to achieve large crowns that could easily approach 25-30 feet in diameter within 20 years. If the planted trees were the only ones to grow in the area, experienced little mortality, and had ideal growing conditions, they could achieve up to 90% canopy closure within the first 20 years of planting, based on the spacing. However, with a mixture of species in the plantings and about a 25% mortality rate, it is not unreasonable to expect a 40-60% canopy closure in about 25 years.

The time it would take to achieve a tree diameter of about 20 inches is more difficult to estimate. Discussions with a Landscape Architect at the Galveston District revealed that an average increase in tree diameter, considering the high variability between species and individuals within a species, would be about 0.5 inch/year over the 50-year period of analysis. This average considers the faster growth rate during the first 10 years after planting and the slower growth rate as the trees mature. Using this assumption, this would require about 37 years (1.5 inches at planting to 20 inches at 37 years) for the forest to reach the maximum habitat value for most of the hardwood species. However, this value will be assigned only at year 45 to provide a more conservative estimate in case growing conditions are not optimal.

While the trees are maturing, natural mortality will increase the amount of snags and refuge sites available for reproduction and cover for the evaluation species. For this analysis, it is assumed that the requisite number of snags will be reached at about year 20.

There are fewer common variables among the three evaluation species for wetland habitat. The wood duck is more dependent in the HSI model on the density of potential nest sites, which can be provided by erecting wooden nest boxes around the wetland site. Other variables which can improve over time are brood cover over the water surface and winter cover. It is assumed that aquatic plants and shrubs are fast growing and can meet these requirements in about 5 years after planting. The variables that increase in value over time for the green heron include herbaceous canopy cover in the near-shore zone and water surface covered by logs and other vegetation. It is assumed that canopy cover will develop in about 5 years and logs and vegetation will accumulate on the water surface in about 25 years. The raccoon is more dependent on tree size and refuge sites which will develop according to the assumptions described for the forest habitat above.

Woodland Scale 1 Assumptions - Restoration using Seedling Caliper Trees

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 –It is assumed there will be little measurable change in forest habitat value one year after planting.
- TY_{15} –Forest is composed of 6-8 inch trees (dbh). Canopy closure of trees is about 30% (for the original plantings and any new volunteers and progeny of the original plantings), with about 20% canopy closure of the hard mast producing trees. Shrubs have established about 5% crown cover.
- TY_{25} – Forest is composed of 10-12 inch trees (dbh). Canopy closure of trees is about 40%, with about 35% canopy closure of the hard mast producing trees. Shrub crown cover is about 12%.
- TY_{45} – Forest overstory is composed of 20 inch dbh trees. Younger trees vary from saplings to 12-14 inches or more. Canopy closure of trees is about 50-60% with hard mast producing trees having a canopy closure of about 45%. Shrub crown cover may be as much as 35%.
- TY_{50} – It is assumed that the habitat quality for forest species is the same as year 45.

Woodland Scale 2 Assumptions - Restoration using 1" Caliper Trees

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 – It is assumed there will be little measurable change in forest habitat value one year after planting.
- TY_{15} – It is assumed that the trees will mature enough to provide measurable habitat quality for the evaluation species. Forest is composed of 8-10 inch trees (dbh). Canopy closure of trees is about 30% (for the original plantings and any new volunteers and progeny of the original plantings), with about 25% canopy closure of the hard mast producing trees. Shrubs have established about 5% crown cover.
- TY_{25} – Forest is composed of 12-14 inch trees (dbh). Canopy closure of trees is about 40%, with about 35% canopy closure of the hard mast producing trees. Shrub crown cover is about 12%.
- TY_{45} – Forest overstory is composed of 20 inch dbh trees. Younger trees vary from saplings to 12-14 inches or more. Canopy closure of trees is about 50-60% with hard mast producing trees having a canopy closure of about 45%. Shrub crown cover may be as much as 35%.
- TY_{50} – It is assumed that the habitat quality for forest species is the same as year 45.

Woodland Scale 3 Assumptions - Restoration using 2" Caliper Trees

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 –It is assumed there will be little measurable change in forest habitat value one year after planting.
- TY_{15} – It is assumed that the trees will mature enough to provide measurable habitat quality for the evaluation species. Forest is composed of 9-11 inch trees (dbh). Canopy closure of trees is about 35% (for the original plantings and any new volunteers and progeny of the original plantings), with about 30% canopy closure of the hard mast producing trees. Shrubs have established about 10% crown cover.
- TY_{25} – Forest is composed of 12-14 inch trees (dbh). Canopy closure of trees is about 40%, with about 35% canopy closure of the hard mast producing trees. Shrub crown cover is about 15%.
- TY_{45} – Forest overstory is composed of 20 inch dbh trees. Younger trees vary from saplings to 12-14 inches or more. Canopy closure of trees is about 50-60% with hard mast producing trees having a canopy closure of about 45%. Shrub crown cover may be as much as 35%.
- TY_{50} – It is assumed that the habitat quality for forest species is about the same as year 45.

Using these assumptions, the habitat value for each sump area was calculated for each evaluation species and a cost of mitigation for each area was developed. Table B-11 presents the projected HSI value for each species for each target year used in the analysis. These HSI values can be used for all proposed mitigation within the sumps to project future with project conditions. Based upon hydrologic evaluation of the proposed project, it is anticipated that the sumps would periodically flood but the analysis indicates that inundation of the areas proposed for planting would not exceed five days in duration on any flood event. The plants selected, once established can tolerate this duration of flooding without significant impacts to their growth and use for wildlife. Occasionally some impacts to nesting species might occur, however the frequency of such events would not greatly disrupt the overall habitat values that would develop.

Table B-11
Evaluation species and HSI Values
For Woodland Species

Species	Target Years Compared	HSI Values for Selected TY's Scale 1	HSI Values for Selected TY's Scale 2	HSI Values for Selected TY's Scale 3
Raccoon	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0.05$	$T_1 = 0.05$
	$T_{15} - T_1$	$T_{15} = 0.1$	$T_{15} = 0.10$	$T_{15} = 0.15$
	$T_{25} - T_{15}$	$T_{25} = 0.25$	$T_{25} = 0.37$	$T_{25} = 0.40$
	$T_{45} - T_{25}$	$T_{45} = 0.9$	$T_{45} = 0.90$	$T_{45} = 0.9$
	$T_{50} - T_{45}$	$T_{50} = 0.9$	$T_{50} = 0.90$	$T_{50} = 0.9$
Barred Owl	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0$	$T_1 = 0$
	$T_{15} - T_1$	$T_{15} = 0$	$T_{15} = 0.04$	$T_{15} = 0.08$
	$T_{25} - T_{15}$	$T_{25} = 0.10$	$T_{25} = 0.12$	$T_{25} = 0.15$
	$T_{45} - T_{25}$	$T_{45} = 1.0$	$T_{45} = 1.0$	$T_{45} = 1.0$
	$T_{50} - T_{45}$	$T_{50} = 1.0$	$T_{50} = 1.0$	$T_{50} = 1.0$
Fox Squirrel	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0$	$T_1 = 0$
	$T_{15} - T_1$	$T_{15} = .50$	$T_{15} = 0.67$	$T_{15} = 0.76$
	$T_{25} - T_{15}$	$T_{25} = 0.96$	$T_{25} = 0.96$	$T_{25} = 0.96$
	$T_{45} - T_{25}$	$T_{45} = 0.96$	$T_{45} = 0.96$	$T_{45} = 0.96$
	$T_{50} - T_{45}$	$T_{50} = 0.96$	$T_{50} = 0.96$	$T_{50} = 0.96$
Downy Woodpecker	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0$	$T_1 = 0$
	$T_{15} - T_1$	$T_{15} = 0.05$	$T_{15} = 0.10$	$T_{15} = 0.15$
	$T_{25} - T_{15}$	$T_{25} = 0.40$	$T_{25} = 0.40$	$T_{25} = 0.40$
	$T_{45} - T_{25}$	$T_{45} = 0.65$	$T_{45} = 0.65$	$T_{45} = 0.65$
	$T_{50} - T_{45}$	$T_{50} = 0.70$	$T_{50} = 0.70$	$T_{50} = 0.70$

IWR-PLAN

IWR-Plan Software was used to perform an incremental analysis of the proposed scales in each of the areas. Table B-12 shows the projected future with mitigation average annual habitat units for each of the proposed sump areas if the proposed scale was implemented. IWR-Plan analyzed each of the proposed eight areas. 65,536 possible combinations were analyzed and there were 994 cost effective combinations. IWR-Plan identified 17 best buy plans. These plans are identified in Table B-13 and shown on Figure A.

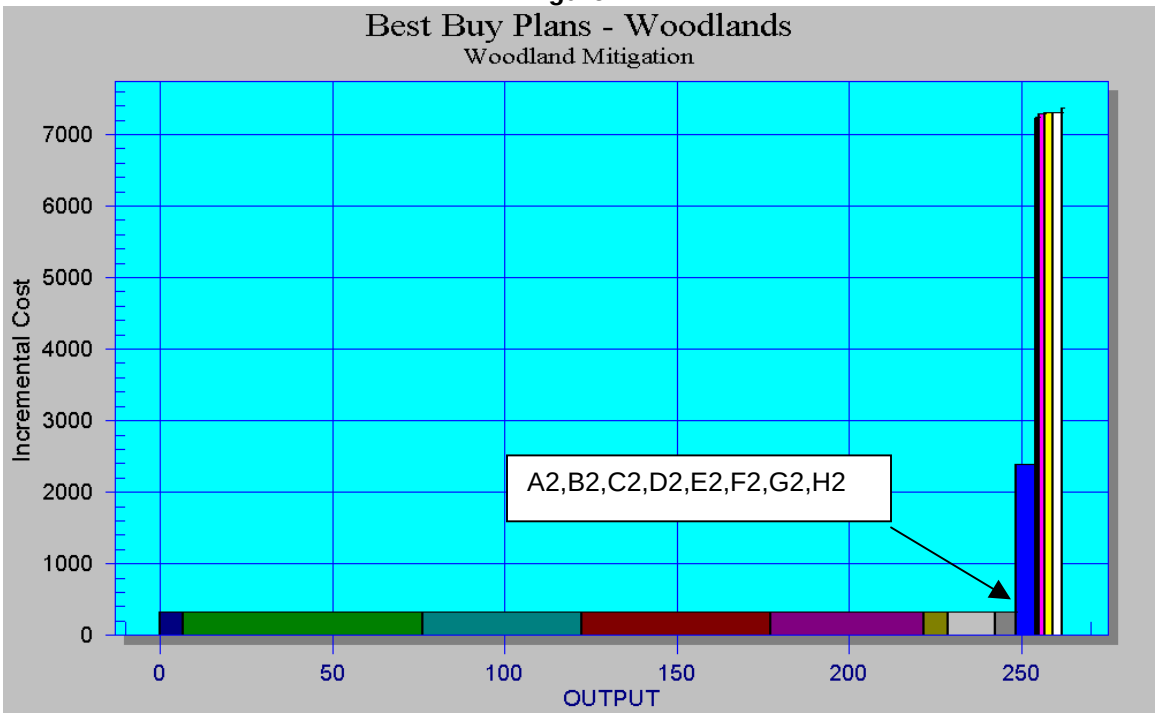
Table B-12
Sump AAHU by Species for Future with Mitigation

Scale	Wal-Mart	Nanya Plastics	Hughes	Ford	Black Collins	Alabama	BS RR	BS Ahldag
Raccoon								
Seedlings	8.90	11.00	13.93	1.19	1.37	2.75	9.30	1.45
1”	9.95	12.29	15.57	1.33	1.54	3.07	10.39	1.62
2”	10.46	12.92	16.36	1.40	1.62	3.23	10.92	1.70
Barred Owl								
Seedlings	7.66	9.46	11.98	1.03	1.18	2.37	8.00	1.25
1”	8.34	10.30	13.04	1.12	1.29	2.58	8.71	1.36
2”	8.78	10.85	13.75	1.18	1.36	2.71	9.18	1.43
Fox Squirrel								
Seedlings	16.79	20.74	26.27	2.25	2.59	5.19	17.54	2.73
1”	17.77	21.96	27.81	2.38	2.74	5.49	18.56	2.89
2”	18.29	22.60	28.63	2.45	2.83	5.65	19.11	2.97
Downy Woodpecker								
Seedlings	7.95	9.82	12.44	1.07	1.23	2.46	8.30	1.29
1”	8.24	10.18	12.89	1.10	1.27	2.54	8.60	1.34
2”	8.53	10.54	13.34	1.14	1.32	2.63	12.69	1.39
Total Seedlings	**41.29**	**51.02**	**64.62**	**5.54**	**6.38**	**12.76**	**43.14**	**6.71**
Total 1”	**44.29**	**54.73**	**69.32**	**5.94**	**6.84**	**13.68**	**46.27**	**7.20**
Total 2”	**46.06**	**56.91**	**72.08**	**6.18**	**7.11**	**14.23**	**51.89**	**7.49**

Table B-13
IWR-Plan Best Buy Plans

Plan	Total AAHU	Total Annual Cost	Incremental Cost	Incremental Output	Incremental Cost Per Unit of Output	Average Annual Cost/AAHU
D2	**6.84**	**2,215**	**2,215**	**6.84**	**323**	**323**
D2,H2	**76.16**	**24,664**	**22,449**	**69.3**	**323**	**323**
D2,F2,H2	**122.43**	**39,649**	**14,985**	**46.27**	**323**	**323**
B2,D2,F2,H2	**177.16**	**57,374**	**17,725**	**54.73**	**323**	**323**
A2,B2,D2,F2,H2	**221.45**	**71,718**	**14,344**	**44.29**	**323**	**323**
A2,B2,D2,F2,G2,H2	**228.65**	**74,050**	**2,332**	**7.2**	**323**	**323**
A2,B2,D2,E2,F2, G2,H2	**242.33**	**78,481**	**4,431**	**13.68**	**323**	**323**
A2,B2,C2,D2,E2,F2,G2,H2	**248.27**	**80,405**	**1,924**	**5.94**	**323**	**323**
A2,B2,C2,D2,E2,F3, G2,H2	253.89	93,875	13,470	5.62	2,396	369
A2,B2,C3,D2,E2,F3, G2,H2	254.13	95,604	1,729	.24	7,204	376
A2,B2,C3,D2,E2,F3, G3,H2	254.42	97,700	2,096	.29	7,227	384
A2,B2,C3,D2,E3,F3, G3,H2	254.97	101,683	3,983	.55	7,241	398
A3,B2,C3,D2,E3,F3, G3,H2	256.74	114,576	12,893	1.77	7,284	446
A3,B3,C3,D2,E3,F3, G3,H2	258.92	130,510	15,934	2.18	7,309	504
A3,B3,C3,D2,E3,F3, G3,H3	261.68	150,688	20,178	2.76	7,310	575
A3,B3,C3,D3,E3,F3, G3,H3	261.95	152,680	1,992	.27	7,377	582
Note: A=Wal-Mart, B=Nanya Plastics, C=Ford, D=Black/Collins, E=Alabama, F=BS Railroad, G=BS Ahldag, and H=Hughes. 1=Seedlings, 2=1" Caliper, 3=2" Caliper						

Figure A



The results displayed in Table B-13 show that implementing the woodland plantings using scale 2 in any of the sumps would be incremental justified and cost effective. Therefore, selecting a few sump locations that would attain the 148.4 AAHU of woodland impacts would satisfy the required mitigation. Since most of the woodland habitat loss is occurring in the Nanya Plastics sump and that area has the most established habitat for connectivity, this area was selected as the first location for mitigation (Figure B-10). The Nanya Plastics Sump would provide 54.73 AAHU. Furthermore, since the Wal-Mart location had the next largest impacts to woodlands, it was also selected (Figure B-9). The Wal-Mart sump would provide 44.29 AAHU, which would bring the cumulative total to 99.02. The Baughman Slough Railroad sump (Figure B-13) would provide an additional 46.27 AAHU, which would bring the cumulative total to 145.29 AAHU. Therefore, one additional sump would be required to meet the 148.4 AAHU of impact. The Ford Street sump would provide 5.94 AAHU, which would bring the cumulative total to 151.23, so it was selected as the final sump that would be used as a mitigation area. The proposed woodland planting using scale 2 in the Nanya Plastic, Wal-Mart, Baughman Slough Railroad, and Ford Street Sumps would provide the required mitigation to fully mitigate the impacts of the proposed levee and sump construction for the Wharton Project. The projected first cost of implementing the forest mitigation is approximately $619,500 with an average annual cost of approximately $48,980. The annual cost per annual habitat unit would be $324.

Wetland Mitigation

Table B-9 shows that a maximum of about 39.9 acres are available in the sumps for planting a mixture of aquatic plant species to compensate for project losses. The maximum available area was used in the HEP analysis because it was not known how much area would be required to fully mitigate the project losses. The Sunset St. Sump will not be considered for any habitat replacement because it is too small to offer any meaningful habitat value for wildlife. To determine the AAHU's the mitigation wetland contains, certain TY's representing the time of expected change in habitat value are needed to measure the gains in habitat value over the 50-year period of analysis. The habitat gains will be reflected in habitat units calculated for each

evaluation species as the trees and wetland vegetation mature. Table B-10 presents a list of trees, shrubs, and wetland vegetation that can be planted in each sump. This list may be modified before construction after additional consultation with the resource agencies and comments from the public during the review period.

Measures and Scales for Wetland Mitigation

The wetland measure would be to plant the identified areas within sumps to establish wetlands. Scales would consist of installing and planting different quantities of founder colony cages within the identified areas the sumps. The cages would be 4' diameter and would protect the plants from herbivores. The cages would be planted with 17 aquatic plants per cage on 24 inch centers. Plants are identified in Table B-10. The proposed scales are as follows:

Low Density

This scale would consist of installing 10 cages per acre.

Medium Density

This Scale would consist of installing 20 cages per acre.

High Density

This scale would consist of installing 40 cages per acre.

Assumptions for Habitat Evaluation and Future with Project Wetland Mitigation

There are fewer common variables among the three evaluation species for wetland habitat than for forest habitat. The wood duck is more dependent in the HSI model on the density of potential nest sites, which can be provided by erecting wooden nest boxes around the wetland site. Other variables which can improve over time are brood cover over the water surface and winter cover. According to Dr. Gary Dick of Lewisville Aquatic Environmental Research Facility the there is data to support that the initial establishment of aquatic plants takes approximately 2 years. After the initial establishment phase, a 4' diameter cage (Approximately 12 sq ft) would spread at a rate of 150% per year for the first five years. Therefore, plantings would cover 30 sq feet after three years, 75 sq ft after four years, 187 sq ft after five years, and 1,170 sq ft after seven years. Based on this, approximately 40 cages per acre are required to achieve maximum restoration within seven years.

The variables that increase in value over time for the green heron include herbaceous canopy cover in the near-shore zone and water surface covered by logs and other vegetation. It is assumed that canopy cover will develop in about 5 years and logs and vegetation will accumulate on the water surface in about 25 years. The raccoon is more dependent on tree size and refuge sites which will develop according to the assumptions described for the forest habitat above.

Wetland Scale 1 - Restoration using low density of plantings and founder colony cages

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 – Some habitat value may be found in the wetland one year after planting since aquatic plants are fast growing, but it is assumed the value is not measurable. Assuming that half of the planted area would be established approximately .1% of the area would

be covered by aquatic plants. Wood duck boxes will be added to each site to enhance habitat quality for this species.

- TY_5 – Aquatic plants are assumed to be partially established and producing food and cover for young animals and for winter cover. 4.3% of the restored area would be covered in aquatic plants. Shrubs and other vegetation are large enough to provide cover for young animals and for winter cover. Trees are not mature enough to provide the quality habitat needed for species requiring mature woods. Water in wetlands is less 12 inches during the hot summer months. Wood duck boxes will be maintained for habitat quality throughout the life of the project.
- TY_{15} – Aquatic plants would be established on 100% of the wetland area. Logs and other woody debris are accumulating in the ponds and may cover up to 10% of the water surface.
- TY_{25} – Logs and other woody debris are accumulating in the ponds and may cover up to 15% of the water surface.
- TY_{50} –Logs and other woody debris are accumulating in the ponds and may cover up to 30% of the water surface.

Wetland Scale 2 - Restoration using a medium density of plantings and founder colony cages

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 – Some habitat value may be found in the wetland one year after planting since aquatic plants are fast growing, but it is assumed the value is not measurable. Assuming that half of the planted area would be established approximately .2% of the area would be covered by aquatic plants. Wood duck boxes will be added to each site to enhance habitat quality for this species.
- TY_5 – Aquatic plants are assumed to be partially established and producing food and cover for young animals and for winter cover. 8.6% of the restored area would be covered in aquatic plants. Shrubs and other vegetation are large enough to provide cover for young animals and for winter cover. Trees are not mature enough to provide the quality habitat needed for species requiring mature woods. Water in wetlands is less 12 inches during the hot summer months. Wood duck boxes will be maintained for habitat quality throughout the life of the project.
- TY_{15} – Aquatic plants would be established on 100% of the wetland area. Logs and other woody debris are accumulating in the ponds and may cover up to 10% of the water surface.
- TY_{25} – Logs and other woody debris are accumulating in the ponds and may cover up to 15% of the water surface.
- TY_{50} – Logs and other woody debris are accumulating in the ponds and may cover up to 30% of the water surface.

Wetland Scale 3 - Restoration using a high density of plantings and founder colony cages

- Baseline (TY_0) – Assume the habitat value for the first year is zero.
- TY_1 – Some habitat value may be found in the wetland one year after planting since aquatic plants are fast growing, but it is assumed the value is not measurable. Assuming that half of the planted area would be established approximately .5% of the area would be covered by aquatic plants. Wood duck boxes will be added to each site to enhance habitat quality for this species.
- TY_5 – Aquatic plants are assumed to be partially established and producing food and cover for young animals and for winter cover. 17% of the restored area would be covered in aquatic plants. Shrubs and other vegetation are large enough to provide

cover for young animals and for winter cover. Trees are not mature enough to provide the quality habitat needed for species requiring mature woods. Water in wetlands is less 12 inches during the hot summer months. Wood duck boxes will be maintained for habitat quality throughout the life of the project.

- TY_{15} – Aquatic plants would be established on 100% of the wetland area. Logs and other woody debris are accumulating in the ponds and may cover up to 10% of the water surface.
- TY_{25} –Logs and other woody debris are accumulating in the ponds and may cover up to 15% of the water surface.
- TY_{50} – Logs and other woody debris are accumulating in the ponds and may cover up to 30% of the water surface.

Using these assumptions, the habitat value for each sump area was calculated for each evaluation species and a cost of mitigation for each area was developed. Table B-14 presents the projected HSI value for each species for each target year used in the analysis. These HSI values can be used for all proposed mitigation within the sumps to project future with project conditions. Based upon hydrologic evaluation of the proposed project, it is anticipated that the sumps would periodically flood but the analysis indicates that inundation of the areas proposed for planting would not exceed five days in duration on any flood event. The plants selected, once established can tolerate this duration of flooding without significant impacts to their growth and use for wildlife. Occasionally some impacts to nesting species might occur, however the frequency of such events would not greatly disrupt the overall habitat values that would develop.

Table B-14
Evaluation species and HSI Values
For Wetland Species

Species	Target Years Compared	HSI Values for Selected TY's Scale 1	HSI Values for Selected TY's Scale 2	HSI Values for Selected TY's Scale 3
Raccoon	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0$	$T_1 = 0.05$
	$T_5 - T_1$	$T_5 = 0$	$T_5 = 0.05$	$T_5 = 0.05$
	$T_{15} - T_5$	$T_{15} = 0.10$	$T_{15} = 0.10$	$T_{15} = 0.10$
	$T_{25} - T_{15}$	$T_{25} = 0.50$	$T_{25} = 0.50$	$T_{25} = 0.50$
	$T_{50} - T_{25}$	$T_{50} = 0.95$	$T_{50} = 0.95$	$T_{50} = 0.95$
Wood Duck	$T_1 - T_0$	$T_1 = 0$	$T_1 = 0$	$T_1 = 0.01$
	$T_5 - T_1$	$T_5 = 0$	$T_5 = 0.01$	$T_5 = 0.03$
	$T_{15} - T_5$	$T_{15} = 0.20$	$T_{15} = 0.20$	$T_{15} = 0.20$
	$T_{25} - T_{15}$	$T_{25} = 0.40$	$T_{25} = 0.40$	$T_{25} = 0.40$
	$T_{50} - T_{25}$	$T_{50} = 0.60$	$T_{50} = 0.60$	$T_{50} = 0.60$
Green Heron	$T_1 - T_0$	$T_1 = 0$	$T_1 = .3$	$T_1 = 0.43$
	$T_5 - T_1$	$T_5 = 0.10$	$T_5 = 0.40$	$T_5 = 0.43$
	$T_{15} - T_5$	$T_{15} = 0.90$	$T_{15} = 0.90$	$T_{15} = 0.90$
	$T_{25} - T_{15}$	$T_{25} = 1.0$	$T_{25} = 1.0$	$T_{25} = 1.0$
	$T_{50} - T_{25}$	$T_{50} = 1.0$	$T_{50} = 1.0$	$T_{50} = 1.0$

IWR-PLAN

IWR-Plan Software was used to perform an incremental analysis of the proposed scales in each of the areas. Table B-15 shows the projected future with mitigation average annual habitat units for each of the proposed sump areas if the proposed scale was implemented. IWR-Plan analyzed each of the proposed eight areas. 4,096 possible combinations were analyzed and there were 125 cost effective combinations. IWR-Plan identified 13 best buy plans. These plans are identified in Table B-16 and shown on Figure B.

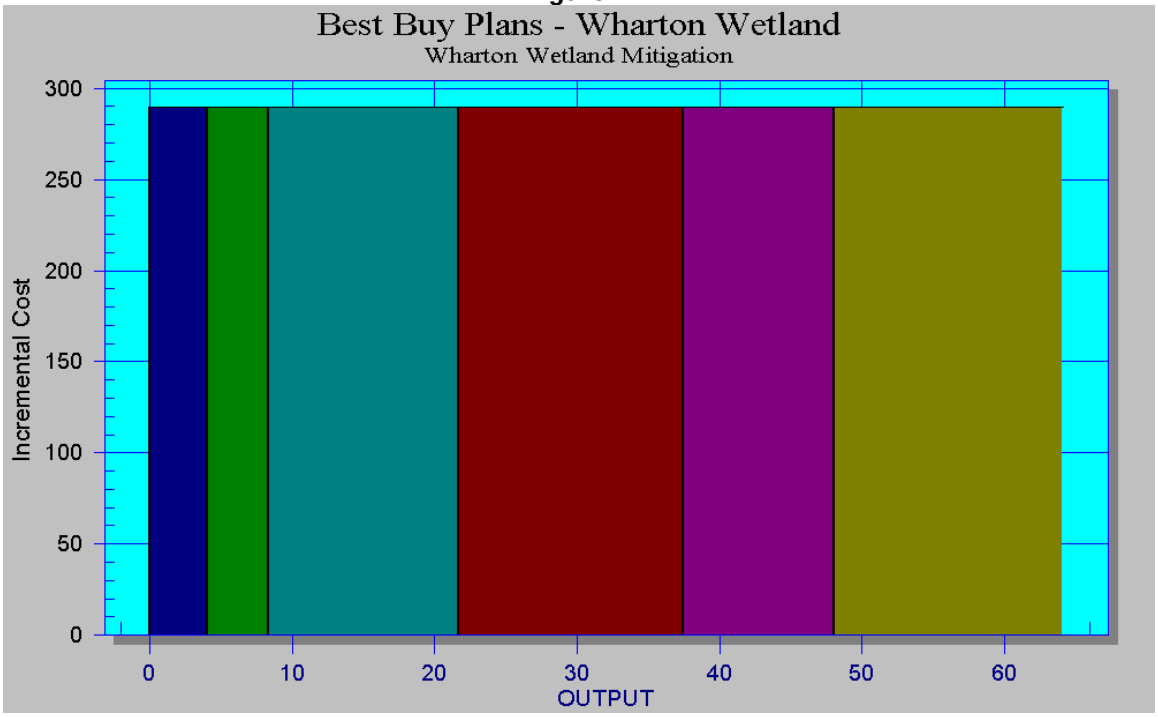
Table B-15
Sump AAHU by Species for Future with Wetland Mitigation

Scale	Wal-Mart	Nanya Plastics	Hughes	Ford	Black Collins	Alabama	BS RR	BS Ahldag
Raccoon								
Low	2.80	4.16	1.14	N/A	N/A	1.06	3.52	4.24
Medium	2.84	4.22	1.16	N/A	N/A	1.08	3.58	4.31
High	2.86	4.25	1.17	N/A	N/A	1.08	3.60	4.33
Wood Duck								
Low	2.14	3.17	0.87	N/A	N/A	0.81	2.69	3.24
Medium	2.14	3.18	0.88	N/A	N/A	0.81	2.70	3.25
High	2.17	3.22	0.89	N/A	N/A	0.82	2.72	3.28
Green Heron								
Low	5.14	7.63	2.10	N/A	N/A	1.95	6.46	7.78
Medium	5.51	8.18	2.25	N/A	N/A	2.09	6.92	8.34
High	5.58	8.28	2.28	N/A	N/A	2.11	7.01	8.45
Total Low	**10.07**	**14.95**	**4.12**	**0**	**0**	**3.81**	**12.67**	**15.26**
Total Medium	**10.49**	**15.58**	**4.29**	**0**	**0**	**3.98**	**13.20**	**15.90**
Total High	**10.60**	**15.74**	**4.34**	**0**	**0**	**4.02**	**13.33**	**16.06**

Table B-16
IWR-Plan Best Buy Plans for Wetland Mitigation

Plan	Total AAHU	Total Annual Cost	Incremental Cost	Incremental Output	Incremental Cost Per Unit of Output	Average Annual Cost/AAHU
E3	4.02	1164	1164	4.02	289	289
E3,H3	8.36	2421	1257	4.34	289	289
E3,F3,H3	21.69	6285	3864	13.33	289	289
B3,E3,F3,H3	37.43	10848	4563	15.74	289	289
A3,B3,E3,F3, H3	48.03	13921	3073	10.6	289	289
A3,B3,E3,F3, G3,H3	64.09	18,577	4656	16.06	289	289
Note: A=Wal-Mart, B=Nanya Plastics, E=Alabama, F=BS Railroad, G=BS Ahldag, and H=Hughes. 1=Low Density, 2=Medium Density, 3=High Density						

Figure B



The results displayed in Table B-16 show that implementing any combination of the plans would be cost effective and incrementally justified. Therefore, selecting a sump location or combinations of sump locations that would attain the 12.2 AAHU of wetland impacts would satisfy the required mitigation. Since most of the wetland habitat loss is occurring in the Nanya Plastics sump and that area has the most established habitat for connectivity, this area was selected as the first location for mitigation (Figure B-10). The Nanya Plastics Sump would provide 15.74 AAHU. The proposed wetland planting using the High Density Scale in the Nanya Plastic sump would provide the required mitigation to fully mitigate the impacts of the proposed levee and sump construction for the Wharton Project. The projected first cost of implementing the wetland

mitigation is approximately $52,675 with an average annual cost of approximately $4,563. The annual cost per annual habitat unit would be $289.

Incremental Analysis Summary

Based on the cost effectiveness/Incremental analysis that was conducted it was concluded that establishing woodlands in the Nanya Plastic, Wal-Mart, Baughman Slough Railroad, and Ford Street Sumps by planting 50 one to two inch caliper trees on 40-foot centers would satisfy the woodland impact of 148.4 AAHU on 65 acres by providing 151.23 AAHU of woodlands on about 84 acres. In addition, establishing wetlands in the Nanya Plastic sump by planting 40 cages per acre with 17 plants per cage would satisfy the required wetland impacts of 12.2 AAHU on 10 acres by providing 15.74 AAHU of wetland habitat on about 10 acres.

The preliminary cost for implementing the mitigation plan is estimated at about $672,175 for planting trees, shrubs, and wetland vegetation, as well as using protective cages for the wetland vegetation until they become established. An additional $92,312 would be required for perimeter fencing, which would bring the total first cost of mitigation to $746,025. The perimeter fences would be to keep cattle out of the sites. Since it was a shared cost for wetlands and woodlands, the cost could not be added to the incremental analysis, it had to be added after the fact.

Planting and Management Plan for the Habitats in the Sump Mitigation Sites

A management plan for managing and manipulating the newly created habitat in order to achieve maximum habitat quality in the shortest time and to maintain habitat quality will be developed with the help of interested resource agencies for the local sponsor to follow once the project is completed and becomes operational. The management plan with goals and objectives and success criteria will be developed during detailed planning in coordination with resource agencies during the PED Phase. The simplest plan is to plant the vegetation or excavate the wetlands and let nature take its course. However, for this project, a more proactive approach is taken without placing an unreasonable burden and expense on the local sponsor.

For preliminary planning and cost estimation purposes, it is anticipated that the trees will be planted in the sumps after construction as part of the project at the rate of 50 trees per acre. They will be planted in a random pattern to leave some open areas for grasslands to develop. The open areas will be seeded with native grasses to reestablish the prairie habitat that once existed in the area. Shrubs will be planted at the rate of about 50 or more plants with 3-4 plants spaced around the base of some of the trees to prevent the plants from quickly covering the open prairie habitat. Additional shrubs may be planted around the wetlands along with cypress trees to provide cover for wildlife. Mowing and cattle grazing will not be used to control vegetation, except in unusual circumstances and after coordination with the resource agencies. Dead standing trees and fallen timber and limbs will be allowed to accumulate to provide habitat diversity.

The young vegetation will be protected from cattle grazing, initially, using a barbed wire fence placed around the perimeter of the sumps. Nest boxes for wood ducks will be placed on poles at appropriate heights at the rate of 5 per acre of wetland around the perimeter of the pond and in the water.

Periodic inspections will be needed to repair fences and nest boxes. The areas also will be inspected for invasion of Chinese tallow trees, huisache, and other noxious vegetation and removed using techniques to be developed during detailed planning. The frequency of the inspections and repairs also will be developed during detailed planning.

COMPLIANCE WITH THE TEXAS COASTAL MANAGEMENT PROGRAM

The State of Texas submitted the Texas Coastal Management Program (TCMP) to the National Oceanic and Atmospheric Administration for review pursuant to Section 306 of the Federal Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq. The TCMP was approved by the Office of Ocean and Coastal Resource Management in 1996. Federal approval of the TCMP requires that Federal activities occurring within the TCMP boundary be consistent with the goals and policies of the TCMP. To show compliance, Federal agencies responsible for these actions must prepare a consistency determination and submit it to the State for review.

The flood control project in Wharton County is not subject to review under the TCMP because it is upstream from the TCMP boundary on the Colorado River. This boundary is established at a point 1.3 miles downstream of the Missouri-Pacific Railroad bridge in Matagorda County. Therefore, a consistency determination for the TCMP has not been prepared for this project.

SECTION 404 COMPLIANCE

The project would affect Waters of the U.S and would therefore require water quality certification. A 404 (b)(1) analysis was completed and provided below.

EVALUATION OF SECTION 404(b)(1) GUIDELINES (SHORT FORM)

PROPOSED PROJECT: Wharton Flood Damage Reduction Project, Wharton County, Texas.

	Yes	No*
1. Review of Compliance (230.10(a)-(d))		
A review of the proposed project indicates that:		
a. The placement represents the least environmentally damaging practicable alternative and, if in a special aquatic site, the activity associated with the placement must have direct access or proximity to, or be located in the aquatic ecosystem, to fulfill its basic purpose (if no, see section 2 and information gathered for EA alternative).	X	
b. The activity does not appear to:		
1) Violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act;	X	
2) Jeopardize the existence of Federally-listed endangered or threatened species or their habitat; and	X	
3) Violate requirements of any Federally-designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies).	X	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, an economic values (if no, see values, Section 2)	X	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see Section 5)	X	

	Not Applicable	Not Significant	Significant*
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
1) Substrate impacts		X	
2) Suspended particulates/turbidity impacts	X		
3) Water column impacts	X		
4) Alteration of current patterns and water circulation	X		
5) Alteration of normal water fluctuation/hydroperiod	X		
6) Alteration of salinity gradients	X		
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
1) Effect on threatened/endangered species and their habitat	X		
2) Effect on the aquatic food web		X	
3) Effect on other wildlife (mammals, birds, reptiles and amphibians)		X	

1

	Not Applicable	Not Significant	Significant*
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
c. Special Aquatic Sites (Subpart E)			
1) Sanctuaries and refuges	X		
2) Wetlands	X		
3) Mud flats	X		
4) Vegetated shallows	X		
5) Coral reefs	X		
6) Riffle and pool complexes	X		
d. Human Use Characteristics (Subpart F)			
1) Effects on municipal and private water supplies	X		
2) Recreational and Commercial fisheries impacts	X		
3) Effects on water-related recreation	X		
4) Aesthetic impacts		X	
5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves	X		

	Yes
3. Evaluation of Dredged or Fill Material (Subpart G)	
a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material (check only those appropriate)	
1) Physical characteristics	X
2) Hydrography in relation to known or anticipated sources of contaminants	
3) Results from previous testing of the material or similar material in the vicinity of the project	
4) Known, significant sources of persistent pesticides from land runoff or percolation	X
5) Spill records for petroleum products or designated (Section 311 of Clean Water Act) hazardous substances	X
6) Other public records of significant introduction of contaminants from industries, municipalities or other sources	
7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	

List appropriate references:

1) All agriculture fields near the dredge and fill sites on Baughman Slough, the sumps, and ditch crossings are pastures used for cattle grazing. Pesticides are not used on these fields.

2) National Response Center – Public Report URL http://www.nrc.uscg.mil/

	Yes	No
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and placement sites and not likely to degrade the placement sites, or the material meets the testing exclusion criteria.	X	

	Yes
4. Placement Site Delineation (230.11(f))	
a. The following factors as appropriate, have been considered in evaluating the placement site:	N/A
1) Depth of water at placement site	
2) Current velocity, direction, and variability at placement site	
3) Degree of turbulence	
4) Water column stratification	
5) Discharge vessel speed and direction	
6) Rate of discharge	
7) Fill material characteristics (constituents, amount, and type of material, settling velocities)	
8) Number of discharges per unit of time	
9) Other factors affecting rates and patterns of mixing (specify)	

List appropriate references:

1) The placement areas for the material removed from Baughman Slough and the sumps are located in pastures. The material will be removed in the dry by mechanical means, such as back-hoes, and will be transported by truck to the placement area. This action will not affect any wetlands, streams, or rivers, other than the improved sections of Baughman Slough. This will be a one-time placement of material only.

	Yes	No
b. An evaluation of the appropriate factors in 4a above indicates that the placement site and/or size of mixing zone are acceptable.	N/A	

	Yes	No
5. Actions to Minimize Adverse Effects (Subpart H)		
All appropriate and practicable steps have been taken, through application of recommendations of 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	

List actions taken:

1) The material will be mechanically dredged in the dry and placed in upland pastures; therefore there will be no TSS or turbidity issues. Fill material used to construct flood protection levees will be placed by mechanical means and best management practices, such as hay bales, jute matting, and mulching, will be used to reduce the

amount of material spilling outside the construction footprint. The stockpiled material will be reseeded with native vegetation once excavation and storage is completed.

	Yes	No*
6. Factual Determination (230.11)		
A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:		
a. Physical substrate at the placement site (review Sections 2a. 3, 4, and 5 above)	**X**	
b. Water circulation, fluctuation and salinity (review Sections 2a. 3, 4, and 5)	**N/A**	
c. Suspended particulates/turbidity (review Sections 2a. 3, 4, and 5)	**N/A**	
d. Contaminant availability (review Sections 2a. 3, and 4)	**X**	
e. Aquatic ecosystem structure and function (review Sections 2b and c, 3, and 5)	**X**	
f. Placement site (review Sections 2, 4, and 5)	**X**	
g. Cumulative impacts on the aquatic ecosystem	**X**	
h. Secondary impacts on the aquatic ecosystem	**X**	

7. Evaluation Responsibility	
a. This evaluation was prepared by:	**Terrell W. Roberts**
Position:	**Wildlife Biologist**

8. Findings	Yes
a. The proposed placement site for discharge of or fill material complies with the Section 404(b)(1) Guidelines.	**X**
b. The proposed placement site for discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines with the inclusion of the following conditions:	

List of conditions:

c. The proposed placement site for discharge of dredged or fill material does not comply with the Section 404(b)(1) Guidelines for the following reason(s):	
1) There is a less damaging practicable alternative	
2) The proposed discharge will result in significant degradation of the aquatic ecosystem	
3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem	

8/9/06 Date	Carolyn Murphy CAROLYN MURPHY Chief, Environmental Section

NOTES:

* A negative, significant, or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

Negative responses to three or more of the compliance criteria at the preliminary stage indicate that the proposed projects may not be evaluated using this "short form" procedure. Care should be used in assessing pertinent portions of the technical information of items 2a-d and 3a-b before completing the final review of compliance.

Negative response to one of the compliance criteria at the final stage indicates that the proposed project does not comply with the Guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form" evaluation process is inappropriate.

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